OPERATOR/MAINTENANCE
INSTRUCTION MANUAL
TM-0110-7/SEPT. 1975
For all units with serial no. prefix "D"

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, JACKSONVILLE
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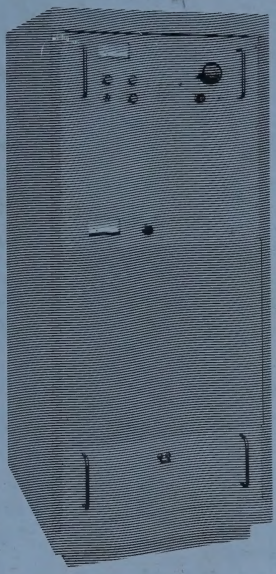
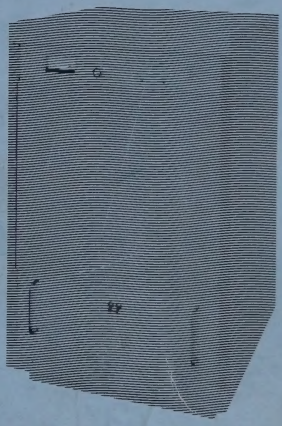




SR-110B
1 KW LINEAR POWER AMPLIFIER

WITH SYSTEM INFORMATION FOR

SR-116 HF SSB TRANSMITTER
SR-120 HF SSB TRANSCEIVER
SR-130 HF ISB TRANSMITTER

(716) 458-3733

SR SYSTEMS

SCIENTIFIC RADIO SYSTEMS INC.
367 ORCHARD STREET
ROCHESTER, NEW YORK U.S.A.

ADDENDUM TO
SR-110B LINEAR POWER AMPLIFIER INSTRUCTION MANUAL

Following are changes made since publication of your manual. You may wish to note these changes on affected pages. Circuit changes may affect the schematic, the parts list, and the component location diagram.

LPA Main Frame, Unit 1A1, Chapter 6:

1.) C159-C161 have been added at XA2: Cap, cer, .01μF, 20%, 500 Vdcw, P/N C10100
C159 between pins 14 and 16
C160 between pins 16 and 19
C161 between pins 19 and 22

2.) K3 part number has been changed to 150885.

3.) R23 has been changed to 82K, P/N R20823.

Control Board Assembly 1A1A1, Chapter 7:

1.) C23 has been added between the base and emitter of Q16. C23 is a Cap, tant, 1.0μF, 10%, 35 Vdcw, P/N C41056.

2.) CR13 and CR14 have been changed to 1 kV, 1N4007, P/N CR4007.

3.) R39-R42 have been changed to Res, ww, 220Ω, 5%, 3W, P/N R90012.

4.) R43 has been deleted, and a jumper has been put in its place.

5.) R44 has been changed to 6.8K, P/N R30682.

Servo Board Assembly 1A1A3, Chapter 9:

C33 has been changed to 5.6μF, 10%, 35 Vdcw, P/N C45656.

TABLE OF CONTENTS

CHAPTER	TITLE
1	INTRODUCTION
2	INSTALLATION
3	OPERATION
4	THEORY OF OPERATION
5	MAINTENANCE
6	SR-110 MAIN FRAME UNIT 1A1
7	CONTROL BOARD ASSEMBLY 1A1A1
8	MATRIX BOARD ASSEMBLY 1A1A2
9	SERVO BOARD ASSEMBLY 1A1A3
10	TRIAC BOARD ASSEMBLY 1A1A4
11	POWER SUPPLY UNIT 1A2
12	AR-156 OPTION, VSWR METER, ASSEMBLY 1A1A5
13	AR-170 OPTION, SEPARATE CHANNEL OUTPUTS, ASSEMBLY 1A1A6
14	AR-157 OPTION, OVERVOLTAGE PROTECTION, ASSEMBLY 1A2A2
15	AR-163 OPTION, LINE VOLTAGE AND CURRENT MONITOR, UNIT 1A6
16	AR-158 OPTION, REMOTE FAULT INDICATION CIRCUIT
17	AR-159 OPTION, REMOTE LPA ON/OFF CIRCUIT

WARRANTY

Scientific Radio Systems, Inc. warrants the equipment described in this manual to be free from defects in material and workmanship. This warranty applies to equipment installed and operated under conditions normal to which the equipment is designed and applies for a period of one year from the date of delivery. Scientific Radio Systems, Inc. will repair or replace parts which prove to be defective during the warranty period, provided they are, at our option, returned to Scientific Radio Systems. No other warranty is expressed or implied.

CORRESPONDENCE

-and-

PARTS ORDERING

Whenever writing about or ordering parts for this unit, always refer to the equipment model and serial numbers, and the approximate date of purchase. Spare parts should be ordered by SRS Part Number and Schematic Designation. Manufacturer's type numbers and values are given for reference only; SRS controls particular parameters in replacement parts supplied under its part numbers.

RETURN OF EQUIPMENT

No parts shall be returned to Scientific Radio Systems, Inc. unless the return has been authorized by SRS.

FACTORY ASSISTANCE

Your new Linear Power Amplifier represents the latest in single sideband circuit design techniques. It is built with the highest quality components to the highest possible manufacturing standards. Before it was shipped to you, it was thoroughly inspected, completely tested for proper operation, and run continuously for an extended period. The final test was to operate the unit on the air on all channels and in all modes.

If this unit is carefully installed with a suitable antenna, it should provide trouble-free, top-grade communications for many years. Do not transmit without a good antenna or a dummy load connected, as damage may occur.

Please contact us if you have any questions regarding the installation, operation, or maintenance of your equipment.

CHAPTER 1

INTRODUCTION

1.1 SCOPE.

This Instruction Manual describes the installation, operating procedures, theory of operation, and maintenance of the SR-110 Linear Power Amplifier (LPA) and associated Power Supply. Also included are general information, inter-connections, and operating and alignment procedures for the complete Transmitter or Transceiver system. The associated exciter (Transceiver or Exciter) and remote control equipment or other accessories, if any, are covered by separate manuals. They are treated in this manual as separate "black-box" units.

1.2 SYSTEM FUNCTIONAL DESCRIPTION.

The SR-110 Linear Power Amplifier and its associated Power Supply (one of two or more primary power types) are the basis of a one kilowatt transmitter or transceiver system. Several standard systems are available as follows.

- The SR-110 and its power supply may be supplied in a cabinet for use with any separately housed exciter, such as the SR-206/210 Transceiver. (See cover photo.)

- The SR-110 and its power supply may be housed in a cabinet which contains an SR-206/210 Transceiver as an exciter. The cabinet may also house an optional SR-1650L Remote Control Unit or other accessories. Such a system is called an SR-116 Transmitter (transmit only) or an SR-120 Transceiver.

- The SR-110 and its power supply may be housed in a cabinet which contains an SR-216/220 ISB Exciter. The cabinet may also house certain accessory units. In such a configuration, the system is called an SR-130 ISB Transmitter.

There is also an unlimited number of special system configurations.

A reference designator system has been established to organize maintenance data for the SR-110 in combination with various possible other units and accessories. A list of designators is presented in Table 1-1 for reference. The system may be expanded as necessary for special configurations and further breakdown of subassemblies.

1.3 SR-110 LINEAR POWER AMPLIFIER UNIT, FUNCTIONAL DESCRIPTION.

The SR-110 Linear Power Amplifier is designed to amplify the output of an exciter or transceiver with 65-150 Watt output capability to a level of 1000 Watts peak-envelope or average power, depending on mode of emission. It is suitable for use either in base stations or in marine applications. Modes of operation include usb, lsb, isb, am, cw, fsk, and others depending on the exciter used.

The SR-110 is basically a programmed unit, with eleven rf bands to cover the 1.6-30.0 MHz hf range. The programming system allows internal correlation of up to ten exciter channels with the necessary bandswitch and fine-tune setups required to operate on the exciter frequencies. This scheme provides freedom from restrictions on frequency spacing, channel arrangement, or future frequency changes. Each channel is individually tuned to the assigned frequencies during alignment of the LPA. During subsequent operation, the appropriate channel is automatically selected in response to commands generated by the channel selector switch in the exciter or the remote control unit. A keyline interlock signal is provided to prevent the exciter from delivering rf drive before the LPA completes channel selection.

1.5 POWER SUPPLY UNIT, FUNCTIONAL DESCRIPTION.

The Power Supply provides the 2500 Vdc for the amplifier tubes. (Other power supplies, for low voltages, are contained in the Amplifier Unit.) The standard AR-150A Power Supply operates on a primary power source of 115 or 230 Vac, 50/60 Hz, single-phase ac power. An alternate AR-150B Power Supply operates on 440 Vac, 50/60 Hz, three-phase primary power. (Information is included in the manual only when shipped with this option.)

The SR-110 requires a well regulated power source. It is recommended that two separate lines be run from the power distribution box; one to the Power Supply for the LPA and the other to the exciter and

associated equipment. This precaution minimizes the power line fluctuation, caused by the demands of the LPA, from affecting the exciter output. Under normal operating conditions, the power consumption of the LPA and Power Supply is 2.5 kVA for 1000 Watts average output. Under abnormal conditions, the power consumption of the LPA can be as much as 2.8 kVA.

1.6 PHYSICAL DESCRIPTION.

The LPA and its associated Power Supply are two separate assemblies which are mounted in a 19 inch equipment cabinet. The LPA weighs approximately 45 pounds and is supported on slides within the cabinet. All routine servicing and alignment may be performed from the front of the cabinet by fully extending the LPA on its slides. The entire top of the LPA is shielded and completely enclosed, so that inadvertent contact with lethal rf voltages is impossible.

The Power Supply Unit rests on a special support consisting of angles fixed to the bottom of the cabinet. The supply is designed to slide on those angles for installation or removal. All servicing of the Power Supply may be performed with the unit in place, from the front of the cabinet. All interconnections between the Power Supply Unit and the LPA unit are of the quick-disconnect type.

When the LPA and Power Supply units are used with a separately housed exciter, the cabinet is 20-1/2 inches wide by 34-1/8 inches high by 22-3/8 inches deep. Air is drawn through a decorative perforated panel in the front of the cabinet and exhausted in the rear. A removable air filter is located behind the decorative panel. Cabinets for the SR-116, SR-120, SR-130, and other Transceiver or Transmitter systems are taller to accommodate the exciter and accessory units.

1.7 ANTENNA SYSTEMS.

The LPA is designed to drive a load which is nominally 50 Ohms. This may consist of a 50 Ohm antenna or a non-resonant antenna with an Antenna Coupler, such as the SR-650A, used to match the antenna to the Amplifier. The LPA will temporarily drive any vswr and is fully protected against momentary open or short-circuited output, even under conditions of full drive. Maximum transfer of power, however, occurs at a load of 50 Ohms; so to realize the maximum power advantage of the LPA, it is necessary to match the antenna to the LPA. An operating vswr of 1.5 to 1 or better is therefore recommended for an efficient transmitting system.

1.8 ITEMS SUPPLIED.

Items normally packed separately for the SR-110 include the instruction manual, the two amplifier tubes, cable lugs for power connections, and any mating connectors and cables required, depending on the particular system configuration. Take care, when unpacking the unit, to locate and save these items. Installation instructions will make their use and installation obvious.

TABLE 1-1. UNIT AND ASSEMBLY REFERENCE DESIGNATORS

Ref Desig Prefix	Unit or Assembly Name
1	Transmitter Cabinet
1A1	SR-110 Linear Power Amplifier Chassis
1A1A1	Control Board Assembly
1A1A2	Matrix Board Assembly
1A1A3	Servo Board Assembly
1A1A4	Triac Board Assembly
1A1A5	Fwd/refl Power Sensor Assembly
1A1A6	Separate Channel Output Assembly (option)
1A1A7	Output Relay Assembly
1A2	Power Supply Unit (AR-150A, AR-150B, etc.)
1A2A1	(Not assigned)
1A2A2	Overvoltage Protection Assembly (option)
1A2A3	Line Voltage and Current Sensor Assembly (option)
1A3	Exciter (SR-206/210, SR-216/220, etc.)
1A4	SR-1650L Local Control Unit (if used)
1A5	SR-820 FSK Terminal Unit (if used)
1A6	Line Voltage and Current Monitor (option)
2	SR-650A Antenna Coupler (if used)
3	SR-1601, SR-1601I, or SR-1650R Remote Control Unit (if used)
4, 5, 6 etc.	Other external units, if used in special systems

TABLE 1-2. NOMINAL SPECIFICATIONS, AMPLIFIER AND POWER SUPPLY

Power Output:	1000 Watts p.e.p., 1000 Watts average
Frequency Range:	1.6 to 30 MHz
VSWR Limit:	1.5:1
Metering:	Relative power output, plate current, dc plate voltage, grid current. Optionally, forward and reflected power.
RF Drive Power:	65 Watts minimum
Output Impedance:	50 Ohms single ended
Power Consumption:	2.5 kVA for 1000 Watts average output
Primary Power:	115/230 Vac, 47-63 Hz, single-phase
Cooling:	Forced air
Intermodulation:	-30 dB third-order or better
Harmonic Suppression:	40 dB
Automatic Power Control:	When used with companion exciter, both p.e.p. and average power is controlled into 50 Ohm load. Independent control of power is provided for ssb voice, fsk, and cw modes of excitation.
VSWR Protection:	When used with companion exciter, both rf plate voltage and current are limited to safe levels for any temporary VSWR condition.
Fault Protection:	Excessive plate voltage and plate current disconnect the Amplifier from the line and connect the Exciter directly to the antenna.
Operating Temperature:	-30°C to +50°C
Weight:	LPA Chassis --- 45 lbs (20 kg). Power Supply Chassis --- 95 lbs (43 kg). Overall System in Cabinet --- approximately 260 lbs (120 kg).
Size:	20-1/2 in (52 cm) W, 22-3/8 in (57 dm) D, 34-1/8 in (87 cm) H for LPA and Power Supply in Cabinet; 49-7/8 in (127 cm) H for SR-116, SR-120, or SR-130 System Cabinet.

CHAPTER 2

INSTALLATION

TABLE OF CONTENTS

Paragraph	Title
2.1	Requirements of a Good Installation
2.2	Unpacking and Inspection
2.3	Functional Description
2.4	Siting
2.5	Interior Access
2.6	Tube Installation
2.7	Exciter Interconnections
2.8	Antenna Systems
2.9	Antenna Connections
2.10	Primary Power Wiring
2.11	SR-1650 Remote Control Installation
2.12	SR-1601 Remote Control Installation
2.13	Initial Turn-on Procedure
2.14	System Power Control Adjustments

Figure	Title
2-1	Typical Installation, System
2-2	Typical Installation, Separate Exciter
2-3	System Cabling Diagram
2-4	Location of System Connection Points
2-5	1TB2 Exciter Power Wiring Diagram
2-6	General Test Setup
2-7	VSWR Nomograph

Table	Title
2-1	External Cable Connections
2-2	1W1 System Cable Wire Run List
2-3	LPA Power Supply Harness, 1W2, Wire Run List
2-4	Power Supply Transformer 1A2T1, Line Voltage Jumper Connections
2-5	LPA Transformer 1A1T1, Line Voltage Jumper Connections

2.1 REQUIREMENTS OF A GOOD INSTALLATION.

There are certain requirements which must be given attention during installation to obtain optimum results from a power amplifier such as the SR-110. Consider the following when planning your installation.

a. Obtain the lowest possible primary power source impedance.

b. Install a good antenna system.

c. Locate the exciter within the vicinity of the LPA.

d. Locate the antenna or antenna coupler within 200 cable feet of the LPA.

e. A minimum clearance of 4 inches from the wall to the rear of the cabinet is required for proper ventilation.

f. Provide adequate intake area clearance for cooling air.

g. Provide adequate space for performing routine maintenance.

h. The exciter or remote control should be located for convenient operation.

The importance of the first four items on this list should not be under-estimated. The primary goal of a good installation is to maximize the power delivered to the antenna, and these first four items are directly associated with high power output.

2.2 UNPACKING AND INSPECTION.

Open shipping crate carefully to prevent scratching or damaging the contents. Remove packing material, and save for possible use in reshipment. The equipment should be carefully inspected for damage. If damage is noted, immediately notify the transporter. All items should be checked against the packing list accompanying the shipment.

2.3 FUNCTIONAL DESCRIPTION.

The SR-120 Transceiver is a one-kilowatt channelized hf, ssb transceiver system based on the SR-206/210 Transceiver as an exciter/receiver and the SR-110 Linear Power Amplifier. Figure 2-1 illustrates a typical SR-120 system cabinet.

The SR-116 Transmitter is similar to the SR-120 Transceiver, except that the receiver circuitry is disabled for transmit-only operation. Cabinet configuration is as shown in Figure 2-1.

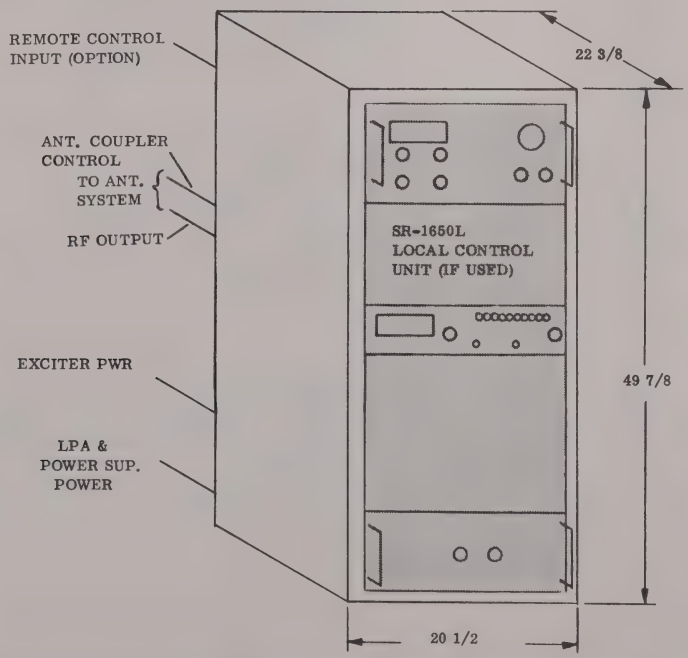


Figure 2-1. Typical Installation, SR-116 Transmitter, SR-120 Transceiver, or SR-130 Transmitter

The SR-110 LPA and its Power Supply can also be supplied in a shorter cabinet for use with a separate exciter. Figure 2-2 shows such a setup, with the SR-206/210 Transceiver as an exciter. In such a case, the ten-foot interconnecting cables for the rf, ppc, and control signals to and from the transceiver allow the transceiver to be located anywhere within cable reach of the LPA, such as on a nearby desk. It is not recommended that the cables be extended beyond ten feet.

2.4 SITING.

Basic cable connections required during installation are shown in Figures 2-1 and 2-2. They are described in detail in text and illustrations which follow. It is recommended that the material be read through before installation, and that a sketch be made of the installation to ensure that adequate planning is done, including details of space requirements, building power facilities, cable routing, etc. Although this approach may seem unnecessary, it often helps in orgainizing the installation tasks.

Cabinet dimensions are given in Figures 2-1 and 2-2. Weight of the cabinet is approximately 260 pounds, depending on configuration. This weight is probably not great enough to cause floor loading problems; however, mechanical lifting and moving equipment may be required for handling during installation.

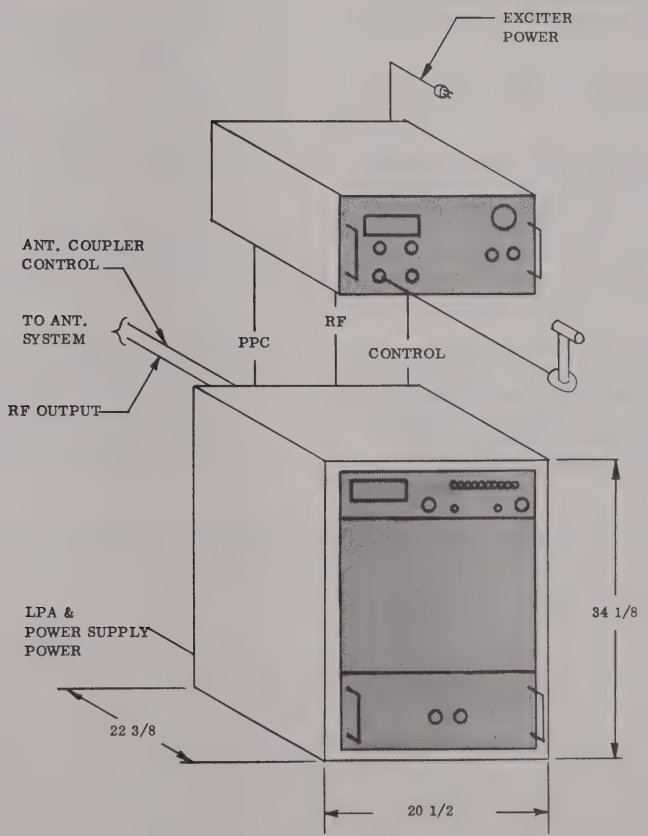


Figure 2-2. Typical Installation, SR-110 LPA and Power Supply with Separate SR-206/210 Transceiver or SR-216/220 Exciter

2.5 INTERIOR ACCESS.

Access to the interior of the equipment cabinet is provided by a removable front perforated panel.

For ease of maintenance, the LPA chassis is mounted on slides within the cabinet. To extract it, remove the front perforated panels beneath the LPA front panel. Remove the LPA panel retaining screws. Grasp the chassis below the filter assembly and gently pull; it will slide out until the rails lock at the end of their travel. To insert the LPA chassis back into the cabinet, a locking button on each rail must be depressed while exerting a gentle backward pressure on the chassis. The exciter and other slide mounted equipment are similarly manipulated.

NOTE

1. Tie Wraps used to support the main cable harness during shipping must be cut off to allow cable to extend with chassis.

2. Remove any meter shorting wires prior to operating the LPA.

The Power Supply chassis is mounted on large rails in the bottom of the equipment cabinet and should not require removal for normal maintenance. If this chassis, or any other, is totally removed from the equipment cabinet, follow the disassembly procedures in the appropriate maintenance information section for that unit.

2.6 TUBE INSTALLATION.

Amplifier tubes 1A1V1 and V2 are specially packed and shipped outside the main equipment cabinet to ensure their safe arrival at the installation site. Access to the top of the chassis is accomplished as follows.

a. Remove the four screws holding the front perforated panel in position, and remove the perforated panel.

b. Remove the four large screws (eight with high-altitude option) retaining the LPA front panel, and extend the Power Amplifier on its slides.

c. Remove the screws holding the Power Amplifier chassis top cover, and remove the cover.

CAUTION

Use extreme caution when handling and installing V1 and V2, especially avoiding any undue pressure on the plate terminal or the base pins. Before physically installing the tubes, unlash the plate leads which have been taped to the body of plate choke of L13.

Use two hands when pushing each tube down into its socket. DO NOT ATTEMPT TO FORCE THE TUBE PINS UNEVENLY INTO THE SOCKET.

d. If equipped with high-altitude option, carefully install chimney over each tube.

e. Carefully place plate cap on the plate terminal at the top of each tube. If any resistance is met, ensure that the plate cap setscrew is not preventing a proper fit. Tighten the plate cap setscrew only enough to prevent the cap from vibrating loose.

f. Having completed the tube installation, re-install the top cover with the twelve screws supplied, push the chassis back into its rack, and reinstall the LPA panel retaining hardware.

2.7 EXCITER INTERCONNECTIONS.

Refer to figure 2-3, which illustrates all cabling between units. If the exciter is furnished in the cabinet with the LPA, all connections (except the front panel microphone) are made at the factory.

If the exciter is located separate from the LPA, connections to 1A3J6, 1A3J2, 1A3J4, and 1A3J3 must be made by uncoiling the appropriate cables from the cabinet and plugging them into SR-206/210 rear panel connectors as shown. (See figure 2-4 for 1TB1 location.) Ten foot cables are supplied, and extension of these cables is not recommended. The exciter and LPA should be located so that cables reach with slack for servicing.

2.8 ANTENNA SYSTEMS.

The following antenna systems are most commonly used.

a. An antenna cut for a specific single frequency such that it produces a 50 Ohm or 75 Ohm load. A "doublet" and an "inverter-V" are examples of this kind of antenna. They can be constructed with an AR-247 Doublet Antenna Kit.

b. Broadband antennas, such as a "log periodic", designed to operate over a band of frequencies and maintain a vswr of better than 2.5:1.

c. Long wire or whip antennas used in conjunction with an SR-650A Antenna Coupler to achieve vswr's of better than 1.5:1 over the entire 1.6 to 30 MHz band.

For optimum results, consult the manufacturer for detailed antenna system recommendations.

Coaxial cable for 1kW power level should be RG-8/U or better. The rf connection for single output (common antenna or antenna coupler) should be made at 1A1A7J3 (coaxial receptacle at bottom of Output Relay Assembly, which is under rear of LPA chassis). If a separate antenna is used for each channel, the LPA must be equipped with the AR-170 Separate Channel Output option. In such a case, connections are made to individual connectors on Separate Channel Output Assembly 1A1A6. Refer to Chapter 13 for connector location information.

2.9 ANTENNA CONNECTIONS.

2.9.1 Operation with SR-650A Antenna Coupler.

When the system includes an antenna coupler in conjunction with a whip or long-wire antenna, as shown in figure 2-3, the manual for the SR-650A should be consulted for cable fabrication and coupler siting. Basically, the rf coaxial cable must be connected to 1A1A7J3, the coaxial output jack on the Output Relay Assembly, shown in figure 2-4; and the multiconductor control cable must be connected to 1W1J1 on the bottom of the terminal bracket, shown in figure 2-4.

2.9.2 Operation with SR-650H Harmonic Filter.

If the system uses an SR-650H, which is a harmonic filter (50Ω output) version of the SR-650 series, installation is similar to that of the SR-650A Antenna Coupler except that the output of the SR-650H is connected to the antenna through a coaxial connector and 50Ω coaxial cable.

2.9.3 Operation with Broadband Antenna.

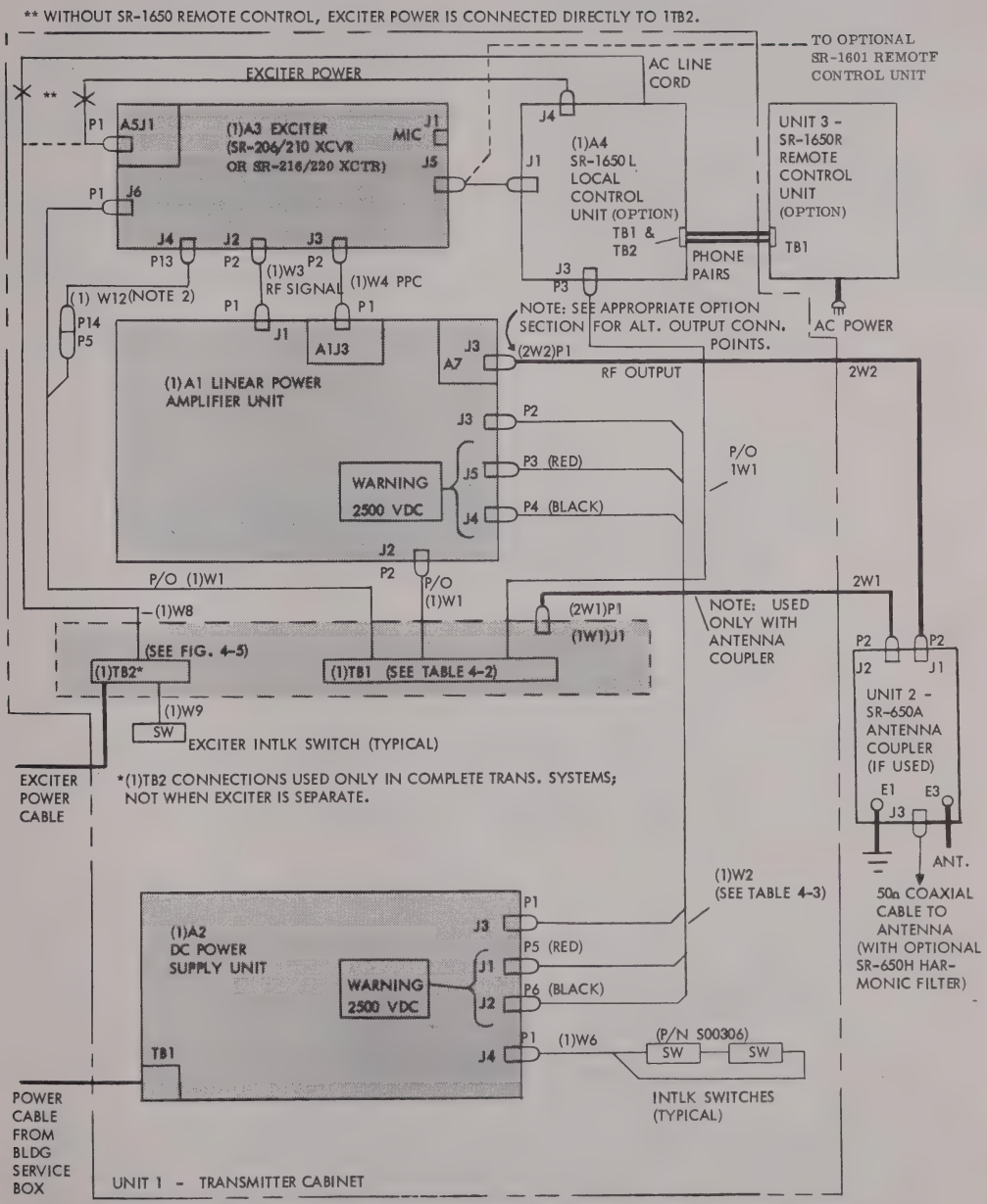
When the LPA is used with a broadband antenna for all channels or when used on only one channel with a tuned antenna, such as a doublet, the only connection required is the rf coaxial cable to 1A1A7J3, shown in figure 2-4. RG-8/U or better 50Ω coaxial cable should be used, and its length should be held to a minimum.

2.9.4 Connections with VSWR Meter Option.

If the SR-110 includes the AR-156 or AR-166 VSWR Meter option, a forward/reflected power sensing

TABLE 2-1. EXTERNAL CABLE CONNECTIONS

FUNCTION	REF DESIG	TYPE	P/N	FROM	TO	NOTE
PRIMARY PWR TO POWER SUPPLY	---	FLEXIBLE PWR CABLE	---	BLDG PWR PANEL	1A2TB1	
EXCITER & SR-1650L POWER	---	FLEXIBLE PWR CABLE	W00006	BLDG PWR PANEL	1TB2	See Fig. 2-4 for location. See Fig. 2-5 for connections.
RF OUTPUT	2W2 2W2P1 2W2P2	RG-8/U UHF N	W13003 P00300 P00250	1A1A7J3	2J1 OR ANTENNA	Alternate rf output point is used if fwd/refl monitor or separate output conn option supplied; see Chapter 12 or 13 for options involved. See SR-650A manual for coupler cable run information.
ANT. COUPLER CONTROL/PWR	2W1 2W1P1 2W1P2	20-COND. SHIELDED 36-PIN MALE MS-3106R-22-14S	W00010 P00253	1W1J1	2J2	Used only with SR-650. See SR-650 manual for cable assembly info.
COUPLER GROUND	---	HEAVY COPPER STRAP, 2 FT. MAX.	---	2E1	EARTH GND	Used only with SR-650. See SR-650 manual.
ANTENNA WIRE	---	---	---	2E2	ANTENNA	Used only with SR-650. See SR-650 manual and antenna instruction sheet.
SR-1650 REMOTE CONTROL	---	MULTIPLE TELEPHONE PAIRS	---	1A4TB1	3TB1	See SR-1650 manual for detailed info.
SR-1601 REMOTE CONTROL	---	---	W00012	1A3J5	SR-1601 (3J2)	See SR-1601 manual for detailed info.



NOTES:
1. HEAVY LINES INDICATE CABLES INSTALLED IN THE FIELD. IN ADDITION, WHEN EXCITER IS SEPARATE, ITS CONNECTIONS MUST BE MADE.
2. 1W12 ALSO INCLUDES A P/N 800002-2 PIGTAIL TO PROVIDE CONNECTION TO EXCITER FAN WHEN ONE IS USED.

Figure 2-3. System Cabling Diagram

element is connected to rf output connector 1A1A7J3. In this case, the antenna system must be connected to the output connector of the sensor instead of 1A1A7J3. See Chapter 12 for more information.

2.9.5 Connections with Separate Channel Outputs.

If the SR-110 includes the AR-170 Separate Channel Output Connector option, a switching and connector assembly is added to the LPA after the 1A1A7J3 output connector. This assembly provides a separate rf output jack for each channel for separate antennas, such as doublets. See Chapter 13 for more information.

2.10 PRIMARY POWER WIRING.

2.10.1 General.

Primary power wiring consists of four tasks:

a. Checking or changing SR-206/210 line voltage.

b. Connecting exciter power.

c. Checking or changing line voltage jumpers in LPA and Power Supply.

d. Connecting LPA and Power Supply primary power.

Procedures for accomplishing these tasks follow.

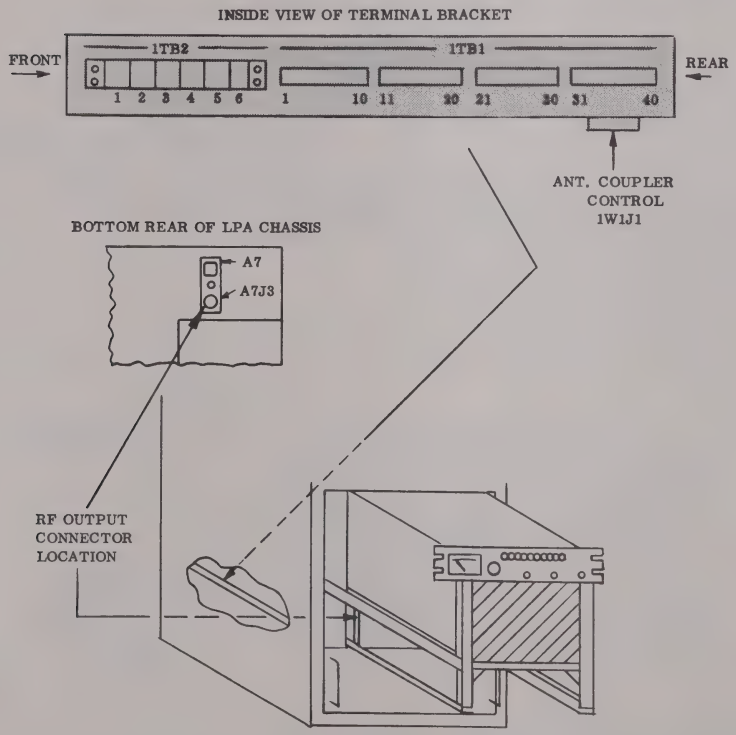


Figure 2-4. Location of System Connection Points

2.10.2 SR-206/210 Line Voltage Selection.

A slide switch is normally provided on the rear panel of the exciter to allow selection of 115 or 230 Vac line voltage. The switch is concealed behind a hole plug to prevent accidental operation. Before connecting exciter to power source, check the setting of the 115/230 switch and change it if necessary.

2.10.3 SR-206/210 Power Connections.

Refer to figure 2-3. If the exciter is mounted in the cabinet with the LPA, exciter power cable from 1TB2 must be connected to ac power source. Figure 2-5 illustrates the exact wiring. (If equipped with AR-157 Overvoltage Protection Option, also refer to Chapter 14.) If the exciter is separate from the LPA cabinet, a separate line cord must be connected from 1A3A5J1 on the exciter directly to the ac power source. A separate power source should be provided for the exciter power in either case. The exciter should not be connected to the line which supplies the LPA and Power Supply.

2.10.4 LPA Power Supply Line Voltage Jumpers.

WARNING

Ensure that power is disconnected before making jumper connections.

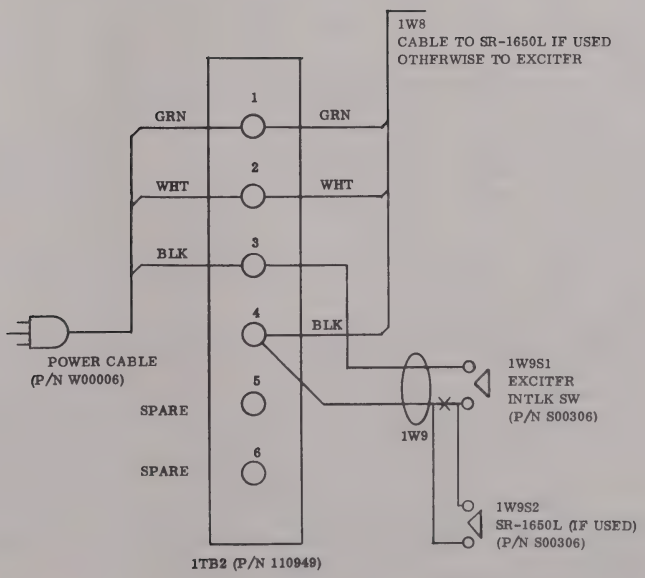


Figure 2-5. 1TB2 Exciter Power Wiring Diagram

TABLE 2-2. 1W1 SYSTEM CABLE WIRE RUN LIST

FUNCTION	1TB1 TERM.	1W1P1 CONNECTION TO EXCITER (M/W 1A3J6)		1W1P2 CONNECTION TO SR-110 LPA (M/W 1A1J2)	1W1P3 CONNECTION TO SR-1650L REMOTE CONTROL UNIT (IF USED) (M/W 1A4J2)	1W1J1 CONNECTION FOR SR-650A ANTENNA COUPLER (IF USED) (M/W 2W1P1)	1W1P5 CONN TO XCVR FAN JACK 1A3J4	
		WITH REMOTE	WITHOUT REMOTE					
CHANNEL 1	1	A	1	1	---	1	---	
CHANNEL 2	2	B	2	2	---	2	---	
CHANNEL 3	3	C	3	3	---	3	---	
CHANNEL 4	4	D	4	4	---	4	---	
CHANNEL 5	5	E	5	5	---	5	---	
CHANNEL 6	6	F	6	6	---	6	---	
CHANNEL 7	7	G	7	7	---	7	---	
CHANNEL 8	8	H	8	8	---	8	---	
CHANNEL 9	9	J	9	9	---	9	---	
CHANNEL 10	10	K	10	10	---	10	---	
COMMON/MOTOR RETURN	11	L	11	11	2	11	---	
+12 VDC FROM EXCITER	12	---	---	12	---	---	---	
KEY STATUS	13	P	14	13	---	---	---	
KEY INHIBIT	14	M	12	14	---	12	---	
KW ON/OFF COMND (1601 OPTION)	15	R	15	15	---	---	---	
GROUND/SHIELD	16	S	16	16	12	21	---	
GROUND	17	S	16	17	4	16	---	
ANT. /AM TUNE	18	N	13	18	---	13	---	
GND TX/+ RX	19	---	---	19	---	---	---	
KW ON/OFF COMND (1650L-OPT)	20	---	---	20	1	---	---	
REMOTE MOTOR	21	T	17	21	---	22	---	
SPARE FROM KW	22	---	---	22	---	---	---	
MOTOR STOP	23	---	---	23	11	---	---	
FWD PWR SIG GND (OPTION)	24	---	---	24	---	---	---	
REFL PWR SIG GND (OPTION)	25	---	---	25	---	---	---	
+ KW FAULT (OPTION NO. 4)	26	---	---	26	6	---	---	
RESERVED FOR KW OPTION	27	---	---	27	---	---	---	
REMOTE KW FAULT	28	---	---	28	---	---	---	
RESERVED FOR KW OPTION	29	---	---	29	---	---	---	
+KW ON/ 0 KW OFF	30	---	---	30	3	---	---	
NOT USED	31	---	---	---	---	---	---	
NOT USED	32	---	---	---	---	---	---	
NOT USED	33	---	---	---	---	---	---	
NOT USED	34	---	---	---	---	---	---	
OPTION NO. 5 COMMAND	35	---	---	---	9	---	---	
OPTION NO. 5 SAMPLE	36	---	---	---	10	---	---	
SPARE FOR KW	37	---	---	31	---	---	---	
SPARE FOR 1650L	38	---	---	---	13	---	---	
SPARE FOR 1650L	39	---	---	---	14	---	---	
SPARE FOR 1650L	40	---	---	---	15	---	---	
115 VAC TO COUPLER	---	---	---	---	---	14, 17, 19	3	
115 VAC RET TO COUPLER	---	---	---	---	---	15, 18	4	
---	---	---	---	---	---	---	---	
---	---	---	---	---	---	---	---	
---	---	---	---	---	---	---	---	

NOTES:
1. EACH TERMINAL OF 1TB1 HAS A .01μF CAP, P/N C10100, TO GROUND FOR RF BYPASSING (1C2-1C41)
2. WHEN SR-1650 REMOTE CONTROL IS SUPPLIED, SR-1650L LOCAL UNIT CONNECTS TO 1W1 AS SHOWN ABOVE, AND SR-1650L ALSO INTERCONNECTS TO EXCITER 1A3J5 VIA SEPARATE CABLE.
3. WHEN SR-1601 REMOTE CONTROL IS SUPPLIED, SR-1601 CONNECTS ONLY TO 1A3J5, NOT 1W1.
4. 1TB1 = FOUR EACH P/N 110948 TERMINAL STRIP.
5. PLUG PART NUMBERS: 1W1J1 = J00253
   1W1P1 (W/REMOTE) = P00254
   1W1P1 (W/O REMOTE) = J00253
   1W1P2 = J00253
   1W1P3 = P00253
   1W1P5 = P00202

TABLE 2-3. LPA/POWER SUPPLY HARNESS, 1W2, WIRE RUN LIST

FUNCTION	FROM LPA		TO POWER SUPPLY	
	RECEPT	PLUG	PLUG	RECEPT
B+ 2500 VDC	1A1J5	1W2P3	1W2P5	1A2J1
B- 2500 VDC RET	1A1J4	1W2P4	1W2P6	1A2J2
SPARE	1A1J3-1	1W2P2-1	1W2P1-1	1A2J3-1
SPARE	1A1J3-2	1W2P2-2	1W2P1-2	1A2J3-2
HV SAMPLE	1A1J3-3	1W2P2-3	1W2P1-3	1A2J3-3
AC LINE	1A1J3-4	1W2P2-4	1W2P1-4	1A2J3-4
AC LINE	1A1J3-5	1W2P2-5	1W2P1-5	1A2J3-5
GROUND	1A1J3-6	1W2P2-6	1W2P1-6	1A2J3-6
115 VAC HIGH	1A1J3-7	1W2P2-7	1W2P1-7	1A2J3-7
115 VAC LOW	1A1J3-8	1W2P2-8	1W2P1-8	1A2J3-8
SPARE	1A1J3-9	1W2P2-9	1W2P1-9	1A2J3-9
SPARE	1A1J3-10	1W2P2-10	1W2P1-10	1A2J3-10
SHIELD/GROUND	1A1J3-11	1W2P2-11	1W2P1-11	1A2J3-11
CONTACTOR POWER	1A1J3-12	1W2P2-12	1W2P1-12	1A2J3-12
(OPTION) KW ON/OFF COMMAND (R/T)	1A1J3-13	1W2P2-13	1W2P1-13	1A2J3-13
REMOTE MOTOR (24 VAC)	1A1J3-14	1W2P2-14	1W2P1-14	1A2J3-14
(OPTION) KW ON/OFF COMMAND (SR-1650L)	1A1J3-15	1W2P2-15	1W2P1-15	1A2J3-15

NOTE: 1. ALL WIRES ARE 22 AWG, EXCEPT 115 VAC IS 10 AWG.

2. PART NUMBERS ARE:
1W2 (CABLE ONLY) = W00010 (MULTI-COND), W07001 (RED), W07002 (BLK)
1W2P1 = J00253
1W2P2 = P00253
1W2P3 = 110895
1W2P4 = 110896
1W2P5 = 110895
1W2P6 = 110896

In the Power Supply Unit, make the following connections at 1A2T2 and 1A2FL1. (See schematic diagram in Chapter 11.)

For 230 Vac operation, connect the black/yellow and black/red wires of 1A2T2 together at FL1-E5. Connect the black wire of 1A2T2 to 1A2FL1-E6. Connect the black/green wire of 1A2T2 to 1A2FL1-E4.

For 115 Vac operation, connect the black and black/red wires of 1A2T2 together, and connect them to 1A2FL1-E6. Connect the black/yellow and black/green wires of 1A2T2 together and connect them to 1A2FL1-E4.

Primary connections for plate transformer 1A2T1 in the Power Supply (see schematic, Chapter 11) and power transformer 1A1T1 in the LPA (see schematic, Chapter 6) are made for either 115 or 230 Vac and also for high and low line conditions. Check the line voltage with a Simpson model 260 or similar multimeter, and make connections for the proper line voltage according to data in tables 2-4 and 2-5.

TABLE 2-4. POWER SUPPLY TRANSFORMER 1A2T1, LINE VOLTAGE JUMPER CONNECTIONS

LINE VOLTAGE VAC	JUMPER		PRIMARY INPUT	
	FROM	TO	FROM	TO
105	1A2T1-1 1A2T1-2	1A2T1-5 1A2T1-6	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-2
115	1A2T1-1 1A2T1-3	1A2T1-5 1A2T1-7	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-3
125	1A2T1-1 1A2T1-4	1A2T1-5 1A2T1-8	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-4
210	1A2T1-2	1A2T1-5	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-6
230	1A2T1-3	1A2T1-5	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-7
250	1A2T1-4	1A2T1-5	1A2K1E3 1A2K1E4	1A2T1-1 1A2T1-8

2.10.5 Primary Power Source Connections.

The LPA cabinet should be located as close as possible to a low impedance power source. This is particularly true of 115 Vac operation, since the line current approaches 25 Amp. It is recommended that each LPA/Power Supply be connected individually to a heavy service line (100 Amp, if possible) to obtain a low source impedance. The Power Supply is protected by a suitable internal circuit breaker, and thus does not rely on the power line fusing for its own protection. A separate line should be run from the main bus to the exciter and auxiliary equipment. Connections for LPA power should be made at 1A2TB1 in the Power Supply as follows, using crimp lugs supplied.

WARNING

Before making connections, turn off power at source and turn off PA CIRCUIT BREAKER on Power Supply and ON/OFF power switch on LPA. Do not turn on power switch until instructed to do so in initial checkout procedure.

For 115 or 230 Vac two-wire, grounded-common operation, connect hot lead to 1A2TB1-1 and common lead to 1A2TB1-2. Connect a ground lead to chassis ground lug 1A2TB1-3. Preferred wire sizes are no. 8 AWG for 115 Vac and no. 10 AWG for 230 Vac.

For single-phase operation from "delta" or "balanced-Y" 230 Vac, connect one leg of the power source to 1A2TB1-1, and connect another leg to 1A2TB1-2. Connect a ground lead to chassis ground lug 1A2TB1-3.

2.11 SR-1650 REMOTE CONTROL INSTALLATION.

If the system includes an SR-1650 Remote Control, multiple telephone pairs must be installed between the SR-1650 local and remote units. Refer to the SR-1650 Remote Control Instruction Manual for details.

2.12 SR-1601 REMOTE CONTROL INSTALLATION.

If the system includes an SR-1601 Remote Control, a multiconductor cable must be installed from 1A3J5 on the SR-206/210 to 3J2 on the SR-1601. Refer to the SR-1601 Instruction Manual for details.

TABLE 2-5. LPA TRANSFORMER 1A1T1, LINE VOLTAGE JUMPER CONNECTIONS

LINE VOLTAGE VAC	JUMPER		INPUT	
	FROM	TO	FROM	TO
105	1A1T1-1 1A1T1-2	1A1T1-5 1A1T1-6	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-2
115	1A1T1-1 1A1T1-3	1A1T1-5 1A1T1-7	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-3
125	1A1T1-1 1A1T1-4	1A1T1-5 1A1T1-8	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-4
210	1A1T1-2	1A1T1-5	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-6
230	1A1T1-3	1A1T1-5	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-7
250	1A1T1-4	1A1T1-5	Wht/Blu Wht/Grn	1A1T1-1 1A1T1-8

2.13 INITIAL TURN-ON PROCEDURE.

2.13.1 General.

After installation has been completed, the following checkout procedures should be performed to ensure that the system is operating correctly.

Exciter checkout into dummy load... Para. 2.13.2
LPA tuning check into dummy load... Para. 2.13.3
LPA power output check into dummy load... Para. 2.13.4
Antenna vswr check with LPA... Para. 2.13.5
Operational checkout with all modes.. Para. 2.13.6
Power control adjustments (if required).. Para. 2.14

It is especially important that power levels be checked, since the power control loop must be adjusted with the particular exciter and LPA which will be used together.

The output circuit should be fine tuned for each channel, using a dummy load, to ensure optimum output. If the LPA has not been previously tuned for the particular channel frequencies in your exciter, it must be completely programmed and tuned for each channel according to instructions in Chapter 5.

The system then should be operated in various modes and on various channels to ascertain correct operation. It is recommended that all operating instructions for the LPA (Chapter 3), the exciter, and all accessories be read thoroughly before attempting checkout or operation.

NOTE

Each unit is interlocked by primary power interlock switches which open the power circuit for the corresponding units when panels are removed from the LPA or when other units are slid out from operating position. Interlock switches may be defeated in the normal manner for servicing by pulling plungers out. However, whenever it is necessary to defeat an interlock, especially for the LPA, use extreme caution in working on the equipment. Remember that interlock switches are used to protect you from inadvertent contact with voltages up to 2.5 kV.

2.13.2 Exciter Checkout.

a. Connect 50Ω, 1 kW dummy load to LPA output connector in place of antenna cable.

b. Set exciter function switch to TRANSCEIVE (TRANSMIT PTT for SR-216/220), and allow a few minutes for warmup.

c. Set Power Supply PA CIRCUIT BREAKER to OFF, and turn off LPA ON/OFF switch. Exciter rf output will be through-connected to dummy load with LPA turned off.

d. Check receive operation in each channel and mode. No signals will be heard, but controls can be checked for response.

e. Key the exciter, and check transmit operation in each mode. Observe relative power output on exciter panel meter. If a receiver or transceiver is available nearby for listening on the same frequencies, it may be used, although overload may distort the audio somewhat.

2.13.3 LPA Tuning Checkout.

a. Refer to figure 2-6. Connect HP-410C or similar rf vtvm through HP-11042A or similar T-probe adapter inserted in the coaxial line from the LPA to the dummy load.

b. If exciter has no am mode provisions for each channel, connect audio signal generator to MICROPHONE connector J1 on the exciter (as shown in figure 2-6, but without resistors).

c. Turn on PA CIRCUIT BREAKER and LPA ON/OFF switch.

d. Check the LPA for proper channeling and keying without rf excitation (usb or lsb mode with no audio).

e. Check idle current on MULTIMETER in PLATE CURRENT position (approx. 0.18-0.22).

f. Set exciter to am mode. If am mode is not available in some channels, a low power drive signal can be generated in usb or lsb by applying a low level 1000 Hz audio signal. When doing so, set level for 25 Vrms exciter output. Measure exciter output alone by turning off LPA.

g. Key exciter on am on each channel, and check for approximately half scale MULTIMETER indication with meter switch set to FWD PWR, REL. Also, listen for arcing sounds or other unusual signs. Arcing may indicate bandswitch misalignment or components damaged or jarred loose in shipping.

h. Check vtvm indication for am carrier in each channel which has am capability. Am carrier level should be approximately 130-160 Vrms. If not, exciter may not be set up correctly or LPA tuning may need adjustment.

i. Check LPA output network tuning for each channel as follows, using either am carrier or substitute.

j. Remove four screws from perforated panel, and remove panel.

k. Defeat interlock switch behind perforated panel.

l. Remove two screws from perforated cover on pc board housing box under air filter, and set cover aside.

m. Set "tune/operate" switch on Triac Board to "tune" position.

CAUTION

"Tune" position defeats protection circuits. Do not channel set with rf power applied.

n. Refer to schematic and parts location diagrams for Servo Board A3 in Chapter 9, and locate channel tune control for desired channel (A3R21-R30).

o. Key exciter, and adjust channel tune control for maximum rf output indication on MULTIMETER or vtvm. Unkey set.

NOTE

If L18 is tuned to an end stop, the limit switch will initiate a key inhibit, which will prevent normal operation. Make sure that tuning is not at end of range.

p. Repeat tuning procedure for other channels, if necessary; and then reset Triac Board "tune/operate" switch to "operate".

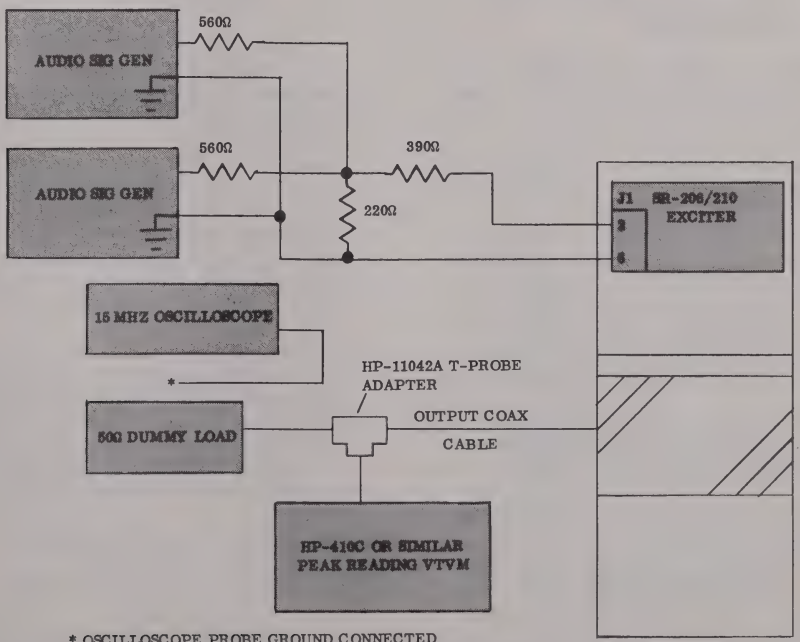
2.13.4 Power Output Checkout.

a. Set exciter channel selector as desired.

b. Set exciter mode selector to USB or LSB position. Set TRANSMIT AUDIO control to the approximate vicinity of the TRANSMIT lamp (SR-206/210 only).

c. Connect any oscilloscope (15 MHz or greater) for envelope display with probe ground to coaxial output cable ground, and lay probe near cable or dummy load to allow pickup.

d. Key exciter, and whistle into the microphone for a sustained period. Observe that LPA MULTIMETER indicates 0.7 to 0.9 in the PLATE CURRENT position and 0.8 to 1.0 in



* OSCILLOSCOPE PROBE GROUND CONNECTED AND PROBE PLACED NEAR LOAD FOR PICKUP

Figure 2-6. General Test Setup

the FWD PWR, REL position. Observe that vtvm indicates output peaks at approximately 185-225 Vrms. Check envelope display on oscilloscope to ensure that output is not flat-topped on top and bottom peaks of signal envelope. Note results if incorrect.

e. Repeat checks on other channels.

If insufficient output is developed or if excessive output is developed with flat-topping noticeable on the oscilloscope, ppc (peak power control) adjustments should be checked and possibly readjusted according to paragraph 2.14. Also, check to ensure that ppc cable is connected between exciter and LPA. Since the procedure requires careful adjustments in both the LPA and the exciter, disturbing the present adjustments should be avoided unless necessary.

Various factors, including frequency, affect the maximum possible output power. The output may vary from channel to channel with no need for concern. Actually, the difference between 800 and 1200 Watts is barely noticeable in a receiver, even on the S-meter. Therefore, if one channel is a little low and another is a little high, it does not affect the communications results and will not damage the equipment providing that excessive flat-topping or current drain does not result.

2.13.5 Antenna VSWR Checkout.

Once the LPA has been checked out and is operating correctly into a 50Ω dummy load, the antenna system is ready for checkout as follows.

a. Connect antenna system to LPA rf output in place of dummy load.

b. If the antenna system includes an antenna coupler, the antenna coupler should be checked for proper channel switching response without rf power; then, it should be set up and tuned for minimum reflected power on the coaxial input line to the coupler. Refer to antenna coupler instruction manual for checkout procedures.

c. If any other antenna system is employed, the antenna system should be checked and adjusted on each channel with low power as follows.

d. Turn off Power Supply PA CIRCUIT BREAKER and LPA ON/OFF switch.

e. Connect a forward/reflected power meter or vswr bridge in coaxial line to antenna system.

f. Set exciter to channel to be checked, and set mode selector to AM.

NOTE

If am mode is not available on all channels, a low power usb or lsb signal can be generated by using an audio signal generator.

g. Key exciter, and check forward and reflected power. (Exciter power will automatically feed through LPA). Vswr should be 1.5:1 or better (less than 5% reflected power). If not, adjust antenna system accordingly.

h. Repeat for all other channels.

i. Restore installation to normal operating condition.

2.13.6 Operational Checkout.

After all tuning and adjustments are completed and the system is restored to normal, try each channel and mode and check for proper operation. You may wish to record meter readings for future reference. If another station is available, perform an on-the-air functional test with that station. If the system includes remote control, refer to operating instructions for remote equipment, and try remote control.

2.14 SYSTEM POWER CONTROL ADJUSTMENTS.

The following procedure describes complete ppc (peak power control) alignment for the SR-110 LPA and an SR-206/210 Transceiver or an SR-216/220 Exciter. Prior to this procedure, it is necessary to have made the test setups and adjustments given in paragraphs 2.13.2, 2.13.3, and 2.13.4. Refer to figure 2-6 for test equipment setup.

a. Disconnect ppc cable from exciter.

b. Measure and record am carrier output from LPA on each channel which has am provision.

c. Adjust am set control 1A3A2C9 on exciter Automatic Carrier Control PC Board (see exciter manual) for 160 Vrms maximum on the highest gain am channel determined above. The lowest gain am channel must have at least 130 Vrms carrier. If not, check exciter rf alignment. Then, if not, call the factory for advice.

d. Turn off LPA ON/OFF switch.

e. Set exciter to lowest am channel.

f. Modulate the exciter in am mode (as shown in figure 2-6) with a single 1.5 kHz tone. Observe oscilloscope envelope pattern, and check for

approximately 80% modulation with full audio as indicated by the oscilloscope envelope display.

g. Reconnect ppc cable to exciter.

h. Remove two screws securing air filter on LPA, and set filter aside.

i. Turn on LPA ON/OFF switch.

j. Set up test equipment for two equal tones of approximately 1000 Hz and 1600 Hz.

k. Set exciter mode selector to usb or lsb.

l. Refer to Chapter 7, and identify channel gain potentiometers for various channels on Control Board A1 (R71-R80).

m. Locate I_B potentiometer R66. Set it maximum cw (viewed from knob side of potentiometer).

n. Set channel selector for channel to be adjusted; key set; and adjust appropriate channel gain potentiometer on Control Board for output limiting at 225 Vrms or maximum undistorted two-tone output, whichever occurs first.

o. Repeat for all other channels.

NOTE

1. Each channel should be in ppc compression; i.e., respond to the appropriate channel gain potentiometer when full drive is applied.

2. Remove two-tone input. Modulate the Exciter with a single tone signal. Select the channel having the highest CW plate current. Adjust R66 ccw (viewed from knob side of pot) until the power just begins to decrease. At this point back off R66 cw approximately one eighth turn maximum.

3. I_B trip set A1R65 and RFV trip set A1R58 (parts of the fault circuits) may require readjustment due to unintentional tripping during ppc alignment. These are located on the Control Board. A1R65 should be adjusted to fault either at 0.9 on the MULTIMETER in PLATE CURRENT position or, optionally, just above the peak current drawn at maximum drive on the highest current channel. A1R58 should be set just above the verge of tripping on the most sensitive channel with regard to fault. (Protection circuit senses plate rf voltage--not output rf voltage.)

p. Modulate the exciter with voice into a microphone. Observe output envelope waveform for all modes on each channel with full voice drive.

NOTE

As noted in paragraph 2.13.4, it is more important to have no distortion than to have maximum output, and adjustments should be made accordingly. If 1 kW (225 Vrms) is not available without distortion, tubes may be aged beyond serviceable life. If it appears that there is a problem which is not understood and 1 kW output must be available, consult the factory for assistance. Meanwhile, set up for an undistorted signal.

q. When all channels are adjusted properly, restore the system to normal operation by disconnecting test equipment and reinstalling covers, etc. You may wish to make any necessary changes to equipment meter reading record, if such is kept.

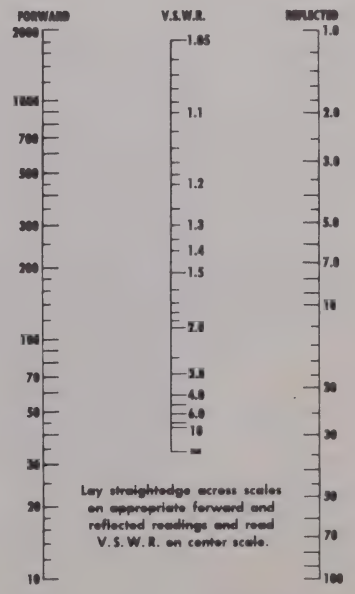


Figure 2-7. VSWR Nomograph

TABLE 3-1. FRONT PANEL CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION
MULTIMETER and Multimeter Selector Switch	The following parameters are indicated by the MULTIMETER as selected by the multimeter switch. GRID CURRENT - A relative indication of grid current is displayed. A maximum of 0.9 should be tolerated for normal operation. PLATE CURRENT - A relative indication of plate current is displayed. A maximum of 0.9 should be tolerated. Operating at greater plate currents will activate a fault circuit. Idle current should be approximately 0.18 to 0.22. HIGH VOLTAGE - A relative indication of Dc plate voltage is displayed. An indication of approximately 0.8 to 0.9 is proper. FWD PWR, REL - Meter indicates relative rf output. REV PWR, REL (optional) - Meter indicates relative reflected power.
CHANNEL lights (1-10)	These lamps, when lit, verify that the LPA has received the proper channel information from the exciter.
RECEIVE light	A green lamp which is lit when the exciter is in receive and the LPA is bypassed by the antenna relays.
TRANSMIT light	A red lamp which lights when the exciter is keyed and the LPA is connected to the antenna. This light blinks during a malfunction. (Both red and green lamps illuminate when a tune condition is used during servicing.)
ON/OFF switch	Activates the primary power contactor for the LPA and associated power supplies. When this switch is OFF, the antenna relays bypass the amplifier circuit and connect the exciter directly to the antenna system.
PA CIRCUIT BREAKER	Protects against LPA and Power Supply primary power overload.

CHAPTER 3

OPERATION

3.1 GENERAL.

The Linear Power Amplifier (LPA) is designed to be slaved to a channelized exciter; it responds to channel commands, and amplifies the rf signal generated by the exciter. In a Kilowatt Transceiver System, the LPA is bypassed in the receive mode. It automatically switches into the system when the exciter (transceiver) is keyed. Thus, under normal conditions the only control, other than those of the exciter, which must be operated is the ON/OFF switch on the front panel of the LPA.

There are, however, controls and indicators which are used for function monitoring and protection, and those are described in the following paragraph.

3.2 LINEAR POWER AMPLIFIER FRONT PANEL CONTROLS AND INDICATORS.

Operating controls and indicators are shown in figure 3-1 and described in table 3-1.

3.3 POWER SUPPLY CONTROL.

A circuit breaker is mounted on the front panel of the Power Supply. This breaker only applies to the Power Supply and LPA units. Other equipments in the same rack, if any, are protected individually. Under normal operating conditions, this circuit breaker should be left in the ON position. Activation and deactivation of the Power Supply and LPA is controlled by the ON/OFF switch on the LPA front panel.

3.4 FAULT PROTECTION AND INDICATION.

The LPA has a fault protection system which automatically removes the amplifier from the transmitting path and connects the exciter directly to the antenna system. When this occurs, the TRANSMIT lamp flashes. Table 3-2 summarizes the fault protection and indication system.

If a fault occurs in the LPA during a transmission, the fault circuit will be activated, the antenna relay will bypass the amplifier circuit, and the TRANSMIT lamp will flash. The operator may continue the transmission, but at the output power level of the exciter.

To reset the fault circuit, the operator must unkey the transmitter momentarily and then re-key. Each time the key is closed, a pulse is generated which resets the fault circuit. If the fault has been cleared, normal operation resumes, as if no fault has occurred. If the fault remains, the equipment immediately reverts to the protected condition with the TRANSMIT lamp flashing. As an option, the fault indications may be remotely displayed at the exciter site if the exciter is not located in the vicinity of the LPA.

3.5 TURN-ON AND SHUT-DOWN PROCEDURE.

The amplifier circuits are protected by a circuit breaker on the Power Supply, which normally should be left in the ON position. After that is turned on, amplifier power is normally turned on and off with the ON/OFF switch on the LPA control panel. All other operation of the LPA is controlled by the exciter.

As an option, the power for the LPA and Power Supply may be turned on and off remotely. If so equipped, the ON/OFF switch on the LPA should be left turned on.

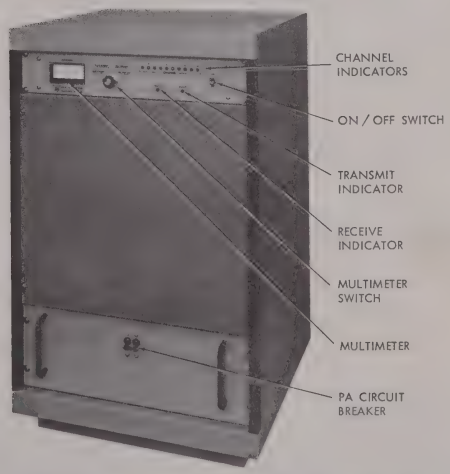


Figure 3-1. Linear Power Amplifier and Power Supply Units, Front Panel Devices

The Exciter may be turned on by setting its function switch to STANDBY, RECEIVE, or TRANSCEIVE. A 20-minute warmup must be allowed prior to transmitting to ensure frequency accuracy. Receive operation may be undertaken immediately if a small frequency inaccuracy can be tolerated.

3.6 OPERATION.

Before attempting to operate this equipment, be sure that the system has been checked by a qualified technician and that all elements of the system are properly tuned and aligned. Refer to Chapter 2 for initial setup and checkout instructions.

CAUTION

Do not channel the LPA/Exciter combination with rf drive applied when the Triac Board tune/operate switch is in the tune (T) position. Damage may result.

a. Energize exciter in receive or standby mode, and allow sufficient warm-up time. Refer to associated instruction manual for exciter operation.

b. Set the circuit breaker on the Power Supply front panel to the ON (up) position.

c. Set the ON/OFF switch on the LPA to the ON position. The RECEIVE lamp and one CHANNEL lamp should light.

d. Set the exciter channel selector switch to the desired channel. The CHANNEL lamps on the LPA will indicate the desired channel. The Antenna Coupler will simultaneously cycle to the desired channel.

e. Set the exciter controls for the desired mode of operation (lsb, usb, isb, am, cw, fsk, etc.).

f. With an SR-206/210 exciter, set TRANSMIT AUDIO control to the 2 o'clock position (pointing to the TRANSMIT indicator). There is no transmit audio control on the SR-216/220 exciter.

g. Key the exciter, and begin transmission. The TRANSMIT lamp should light, and the FWD PWR, REL meter function should give evidence of the transmission.

NOTE

Advancing the TRANSMIT AUDIO control beyond the normal setting in attempts to increase power output only increases background noise pickup and does not add to communications effectiveness. Meter movements cannot respond fast enough to give a true indication of peak output on voice operation.

h. Unkey the exciter. The antenna relay will bypass the amplifier circuit and connect the antenna system directly to the exciter. The TRANSMIT lamp should extinguish, and the RECEIVE lamp should light.

i. Fault condition: If during a transmission a malfunction should occur, the antenna system is automatically connected directly to the exciter output such that the transmission may be continued (at exciter power output) without interruption. The TRANSMIT lamp will flash to indicate the fault condition. At the first possible opportunity, momentarily un-key and then re-key the exciter. If the fault has been cleared, the TRANSMIT lamp will stop blinking and normal operation will resume. If the TRANSMIT lamp still flashes, set the LPA ON/OFF switch to the OFF position. The exciter is now connected to the antenna system, and normal transceive operation may be maintained indefinitely. Troubleshoot the LPA as time permits.

3.7 REMOTE CONTROL OPERATION.

Refer to Remote Control equipment Instruction Manual for operating instructions in remote mode. To allow remote operation, set up local units as previously described. In addition, set exciter LOCAL/REMOTE switch to REMOTE.

TABLE 3-2. FAULT PROTECTION

FAULT	INDICATION	AUTOMATIC PROTECTIVE MEASURE
Excessive plate current or excessive rf plate voltage.	The red TRANSMIT lamp flashes.	Antenna relay bypasses the amplifier circuit, and the tubes are biased off.
Loss of forced air pressure within the LPA chassis.	The red TRANSMIT lamp flashes.	The antenna relay bypasses the amplifier circuit, and both filament power and high voltage are removed from the power amplifier tubes.

CHAPTER 4

THEORY OF OPERATION

TABLE OF CONTENTS

Paragraph	Title
4.1	LPA Chassis, Unit 1A1, Overall Functional Description
4.2	Power Amplifier Circuit
4.3	Bandswitch Circuit
4.4	Servo Circuit
4.5	Rf Peak Power Control Loop
4.6	Keying Circuit
4.7	Fault Circuit
4.8	Meter Circuit
4.9	Power Distribution
4.10	Control Board Assembly 1A1A1
4.11	Matrix Board Assembly 1A1A2
4.12	Servo Board Assembly 1A1A3
4.13	Triac Board Assembly 1A1A4
4.14	Power Supply Unit 2

Figure/Table	Title
Figure 4-1	SR-110 LPA, Functional Block Diagram
Figure 4-2	Power Amplifier Circuit, Simplified Schematic Diagram
Figure 4-3	Bandswitch Circuit, Simplified Schematic Diagram
Figure 4-4	Servo Circuit, Simplified Schematic Diagram
Figure 4-5	Meter Circuit, Simplified Schematic Diagram
Figure 4-6	Power Distribution, Simplified Schematic Diagram
Table 4-1	Band Frequency Ranges

4.1 LPA CHASSIS, UNIT 1A1, OVERALL FUNCTIONAL DESCRIPTION.

The LPA consists of an rf amplifier circuit and associated power supply, control, monitoring, and fault protection circuits. Refer to figure 4-1. Input and output tuned circuits are arranged in eleven bands. The Matrix Board converts channel information to band information; the B1 motor homing switch uses this information to direct bandswitch motor B1 via the Triac Board. The variable inductor in the output network is then tuned by the Servo Amplifier Board and motor B3 in response to channel information and preset programming for each channel. Thus, each channel is automatically tuned as set up during initial alignment. Peak power control for the exciter is developed in the Control Board from an rf sample, using an individual internal setup control for each channel. The Control Board also performs keying control in conjunction with fault detectors on the board. High voltage and switched primary ac power are obtained from the Power Supply Unit.

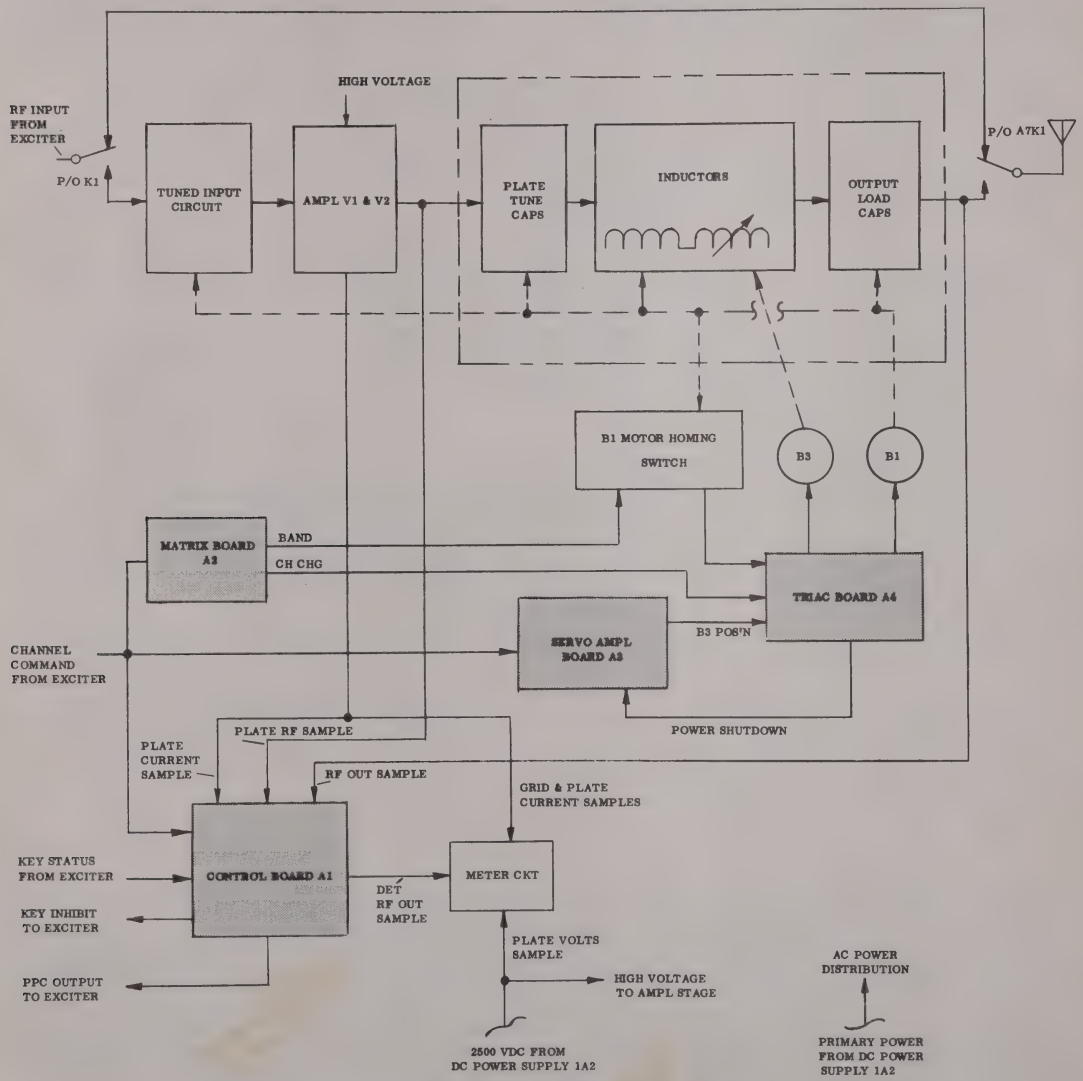


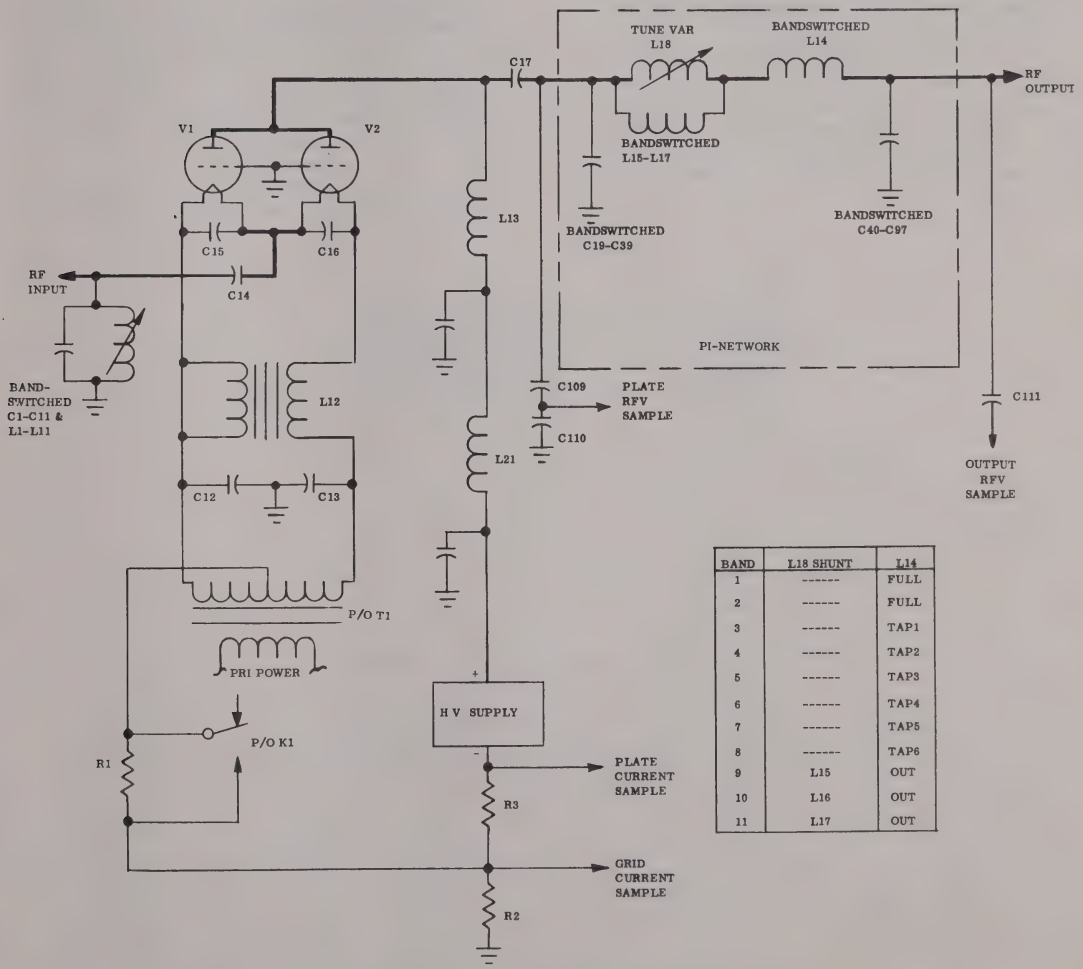
Figure 4-1. SR-110 LPA, Functional Block Diagram

4.2 POWER AMPLIFIER CIRCUIT.

Refer to figure 4-2. A pair of 3-500Z power triodes, V1 and V2, is parallel connected in a grounded grid configuration. The rf output from the exciter is applied to the cathodes (filaments) through C14, C15, and C16. The cathode circuit is tuned by a band switched L-C circuit that presents a nominal 50Ω load to the output of the exciter. A bifilar-wound toroidal choke, L12, and bypass capacitors C12 and C13 are used to isolate the rf signal at the cathode from filament transformer T1.

The output from the plate circuit is coupled to a pi network through blocking capacitor C17. Voltage divider C109-C110 provides a plate rf sample to the Control Board, which uses this signal for ppc and fault protection. An output rf sample is provided by C111 to the Control Board, which detects the signal for the metering circuit.

The output pi network consists of bandswitched input and output capacitors and a variably-tuned coil for tuning within the bands. Series inductor L14 is bandswitched into the circuit on the lower bands to in-



BAND	L18 SHUNT	L14
1	------	FULL
2	------	FULL
3	------	TAP1
4	------	TAP2
5	------	TAP3
6	------	TAP4
7	------	TAP5
8	------	TAP6
9	L15	OUT
10	L16	OUT
11	L17	OUT

Figure 4-2. Power Amplifier Circuit, Simplified Schematic Diagram

crease the inductance range of L18, and inductors L15-L17 are bandswitched in shunt across L18 on the higher bands to decrease the tuning range of L18. The table in figure 4-2 indicates the relationships of L15-L17 and L14 taps with respect to various bands. Table 4-1 defines band frequency ranges.

High voltage, +2500 Vdc, is applied through a pi filter, composed of L21 and associated bypass capacitors, and through plate choke L13 to the plates of V1 and V2. Current flows through V1 and V2 from plate to cathode and through L12 to transformer T1. The plate current is picked off the center tap of T1 and is routed through normally-open contacts of relay K1 to the negative return of the 2500 Vdc supply.

Resistor R1, connected across the K1 relay contacts, functions as a bias-off resistor. When relay K1 is unkeyed, resistor R1 is in series with the cathode circuit, resulting in a self bias condition and biasing off V1 and V2. When K1 is keyed, the self bias is removed; and normal plate current is resumed for class B operation.

Resistor R3, in series with the negative return of the 2500 Vdc supply, provides a plate current monitor sample for the meter circuit. Resistor R2, in series with the grid return (ground) to the cathode return, provides a grid current sample for the meter circuit.

4.3 BANDSWITCH CIRCUIT.

Refer to figure 4-3. The function of the bandswitch circuit is to select groups of rf tuning components for the rf amplifier circuit as a result of an input applied to one of ten channel-control lines from the exciter.

The Matrix Board provides two outputs in response to a channel command from the exciter. First, it provides a signal on one of eleven band lines to homing wafer S1-B on the bandswitch, depending on matrix programming. Second, it applies a pulse signal to the Triac Board, when the channel command is changed, to indicate that retuning is necessary.

The Triac Board is normally inactive; it becomes active when a "channel change" signal is received,

TABLE 4-1. BAND FREQUENCY RANGES

BAND	RANGE (MHZ)
1	2.0 — 2.2
2	2.2 — 2.4
3	2.4 — 2.68
4	2.68 — 3.2
5	3.2 — 4.0
6	4.0 — 5.25
7	5.25 — 7.5
8	7.5 — 14.0
9	14.0 — 18.0
10	18.0 — 25.0
11	25.0 — 30.0

and remains active until tuning activity ceases. Homing switch wafer S1-B is notched so that it passes the band signal from the Matrix Board to the Triac Board, except when the notch is aligned with the contact for the commanded band. Thus, the Triac Board turns on triac Q1, and thereby motor B1, until the notch in the switch wafer reaches the "activated" band. Then, the motor stops.

Motor B1 is equipped with a pawl brake which is controlled by the magnetic field of the stator. When the motor is energized, the stator field disengages the brake and the rotor is free to run. When the motor is de-energized, the stator field collapses and the brake pawl, which is spring loaded, becomes engaged and the motor armature stops.

Even with the brake, motor B1 coasts up to 15° past the point at which the energizing circuit is broken. The stator contacts of wafer S1-B are therefore attached to a plate which may be rotated with respect to the remaining wafers of S1. The angular position of this plate is adjusted so that the rotors of the other wafers stop exactly in the desired position.

Timer relay K3 and fuse F5 are included in the motor circuit to prevent motor and switch damage should the motor be forced to keep running. This problem is inherent in open-seeking switch circuits, since the circuit never turns off if two or more lines are activated at once. Although this can only occur due to malfunction, time delay relay K3 prevents damage by shorting the motor and blowing fuse F5 if the circuit remains on for more than 75 seconds.

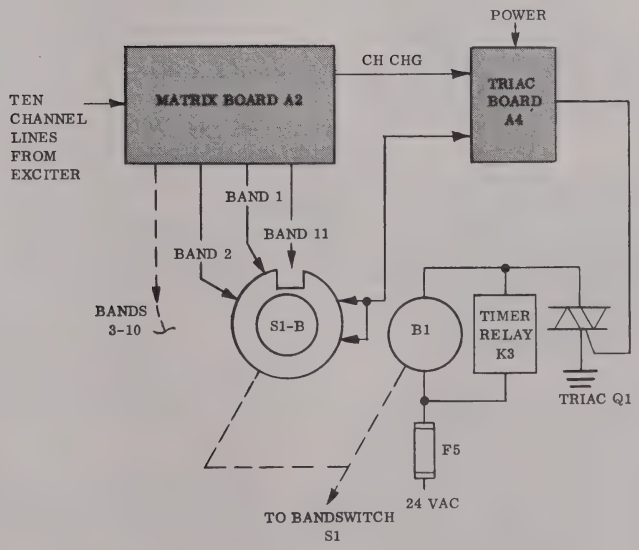


Figure 4-3. Bandswitch Circuit, Simplified Schematic Diagram

4.4 SERVO CIRCUIT.

Refer to figure 4-4. The function of the servo circuit is to position tuning coil L18 in the output network of the rf amplifier circuit. Ten potentiometers in the Servo Board Assembly are adjusted during initial alignment of the LPA, one for each channel. During normal operation, when a new channel is selected and a new channel command is received from the exciter, the servo amplifier circuit in the Servo Board directs the positioning of L18 such that follower potentiometer R29 applies a voltage equal to that from the preset potentiometer for the appropriate channel.

The Triac and Servo Boards are normally inactive. They become inactive when the Triac Board determines that tuning activity has ceased after a channel change. A "power shutdown" line from the Triac Board advises the Servo Board when to rest. These two boards become active again when a channel change is sensed in the Matrix Board and the resulting "channel change" signal is applied to the Triac Board.

Motor B3 may be driven in either direction, as required to satisfy the servo loop. The direction depends on whether the stator field is energized by grounding either terminal 1 or 2 of the motor. Bipolar electrolytic capacitor C108 and resistor R28 are used in conjunction with the ungrounded terminal to cause a phase shift in the stator current, which determines the direction of rotation. The grounding of motor terminals 1 and 2 is done at the appropriate times by the Triac Board.

Limit switches S5 and S6 are mechanically actuated by the roller on coil L18. When the coil approaches the end of its range, a limit switch trips to prevent further rotation in the same direction, thus preventing damage from over-travel. (Also, when a limit switch is tripped, a key inhibit signal is applied to the exciter except when Tune/Operate switch on Triac Board is set to Tune.)

The servo circuit has two speeds: normal speed for long excursions, and one-quarter speed for the final

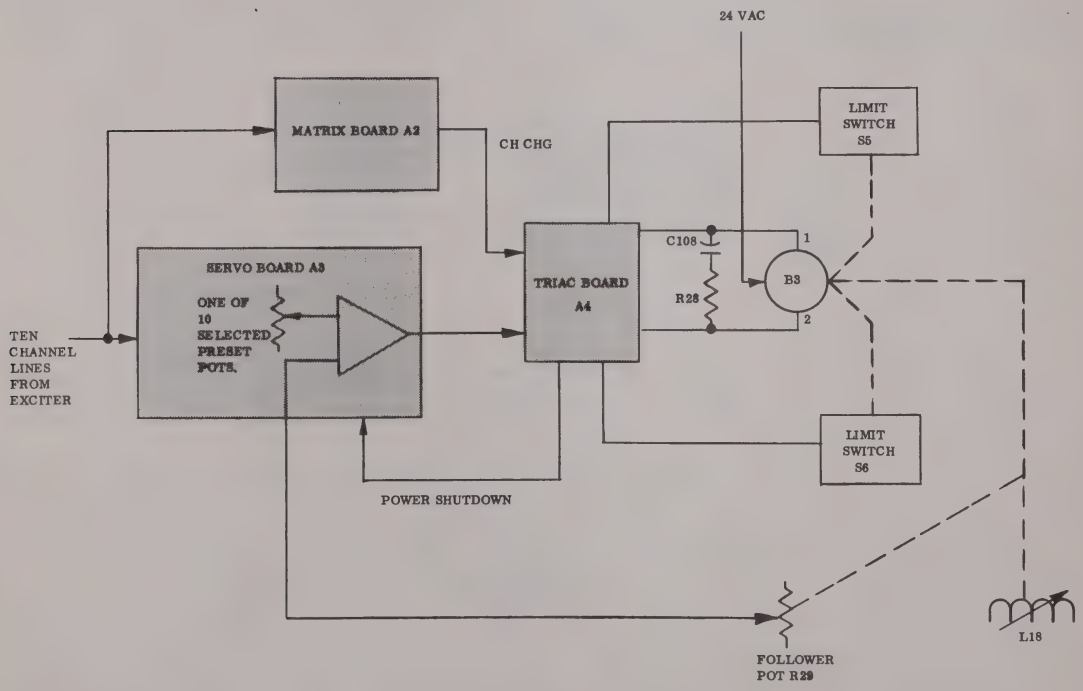


Figure 4-4. Servo Circuit, Simplified Schematic Diagram

30° of rotation. When the inductor reaches the final 5° of rotation, the motor is turned off and coasts a few degrees to a stop. If the motor were to coast too far, the servo loop would correct the detected error by nudging the motor back to the desired position.

The small angular position about either side of the desired position for which the Servo Amplifier de-energizes the Triac Board is called the "dead zone". The Servo Board has an adjustment of this dead zone. If it is adjusted too wide, the inductance is not accurately positioned. If it is adjusted too tightly, the motor will oscillate back and forth about the desired position.

4.5 RF PEAK POWER CONTROL LOOP.

The peak power control circuit in the exciter receives an input from the LPA to limit the rf drive from the exciter. The LPA ppc signal is generated in the Control Board (figure 4-1).

Primary control is a function of the settings of individual channel gain controls. Secondary control is a function of the plate current sample input to the Control Board. This function prevents rf drive levels which would drive the LPA tubes into excessive plate current. Normally, this function would be unnecessary; however, should the tube plate circuit impedance be very low for some reason, the plate current limit would be reached before the rf drive limit.

4.6 KEYING CIRCUIT.

The keying circuit comprises relays K1 and A7K1 and part of the Control Board. The Control Board ensures that proper sequencing is maintained and prevents keying in the event an LPA fault is detected in the Control Board fault circuit.

When the exciter is in a key-up condition, the LPA is in the receive mode, with the following conditions existing.

a. Transmit/receive relays K1 and A7K1 are de-energized, and the antenna is connected to the exciter through normally closed contacts of the relays. (See figure 4-1.)

b. LPA tubes V1 and V2 are biased off by R1 (figure 4-2) which is connected in the cathode circuit of the tubes by normally open contacts of K1.

c. A ground is applied to the exciter keyline inhibit line from the Control Board (figure 4-1).

When the exciter is keyed, the following changes occur.

a. The exciter applies a ground to the LPA Control Board key status input (figure 4-1).

b. The exciter is momentarily prevented from developing an rf drive signal due to the keyline inhibit signal from the LPA Control Board (figure 4-1). This inhibit remains until both K1 and A7K1 are energized.

c. The Control Board applies a ground signal to K1 and A7K1 relay coils, thus energizing them.

d. With K1 energized, K1 contacts short R1 (figure 4-2), removing cutoff bias from V1 and V2 and permitting normal plate current flow.

e. The Control Board removes the keyline inhibit signal from the exciter, and rf drive is developed. The removal of keyline inhibit is time-delayed slightly to allow A7K2 to be completely closed before rf is applied.

When the exciter is unkeyed, key status ground is removed from the Control Board, and the Control Board returns a keyline inhibit to the exciter. Relays K1 and A7K1 are de-energized. An electrical interlock between them ensures that K1 releases before A7K1 to prevent hot-switching the rf output.

The RECEIVE indicator is illuminated whenever A7K1 is de-energized. The TRANSMIT lamp operates from logic circuits in the Control Board, which provide a steady illumination for transmit condition and a flashing illumination when a fault is detected by the Control Board.

4.7 FAULT CIRCUIT.

Refer to figure 4-1. The fault circuit is part of Control Board Assembly A1. Plate current and plate rf voltage samples from the rf amplifier stage are monitored by the Control Board; and if either exceeds a preset level, the Control Board applies a keyline inhibit to the exciter to remove rf drive and flashes the TRANSMIT LAMP. The fault circuit unlatches only after the fault is corrected and the set is unkeyed and rekeyed.

In addition to the above, an air vane switch monitors air flow across the tubes. If air flow drops below normal, the air vane switch disables the power contactor for filament and high voltage. It also applies a voltage to the Control Board to flash the TRANSMIT lamp.

4.8 METER CIRCUIT.

Refer to figure 4-5. The meter circuit is connected through two wafers of MULTIMETER switch S3 to various monitor points as follows.

In the GRID CURRENT position, meter M1 is connected across R2 through series resistor R25. Since all grid current flows from cathodes of V1 and V2 to grids to ground, it must flow through R2.

In the PLATE CURRENT position, the meter is connected across R3 through series resistor R24. All plate current passes through R3 in the high voltage negative return line.

In the HIGH VOLTAGE position, the meter is connected from the negative high voltage return to a sampler circuit on the Control Board. A reduced voltage high-voltage sample from Power Supply 1A2 is applied to a voltage divider consisting of series resistors on the Control Board and R23 on the front panel, which returns to -2500 Vdc. An additional circuit on the Control Board prevents off-scale meter indication when the LPA is unkeyed.

In the FWD PWR, REL position, the meter normally connects to calibration potentiometer A1R62 on the Control Board. The meter signal is developed by detecting an rf output voltage sample from the antenna line.

When the AR-156 VSWR Meter Option is supplied, the connection to the Control Board for relative output voltage is disconnected. In its place, connections from the FWD and REV PWR, REL positions of the meter switch are made to the optional forward/reflected power sensor assembly, which provides relative directional power indications. See Chapter 12 for more details of this option.

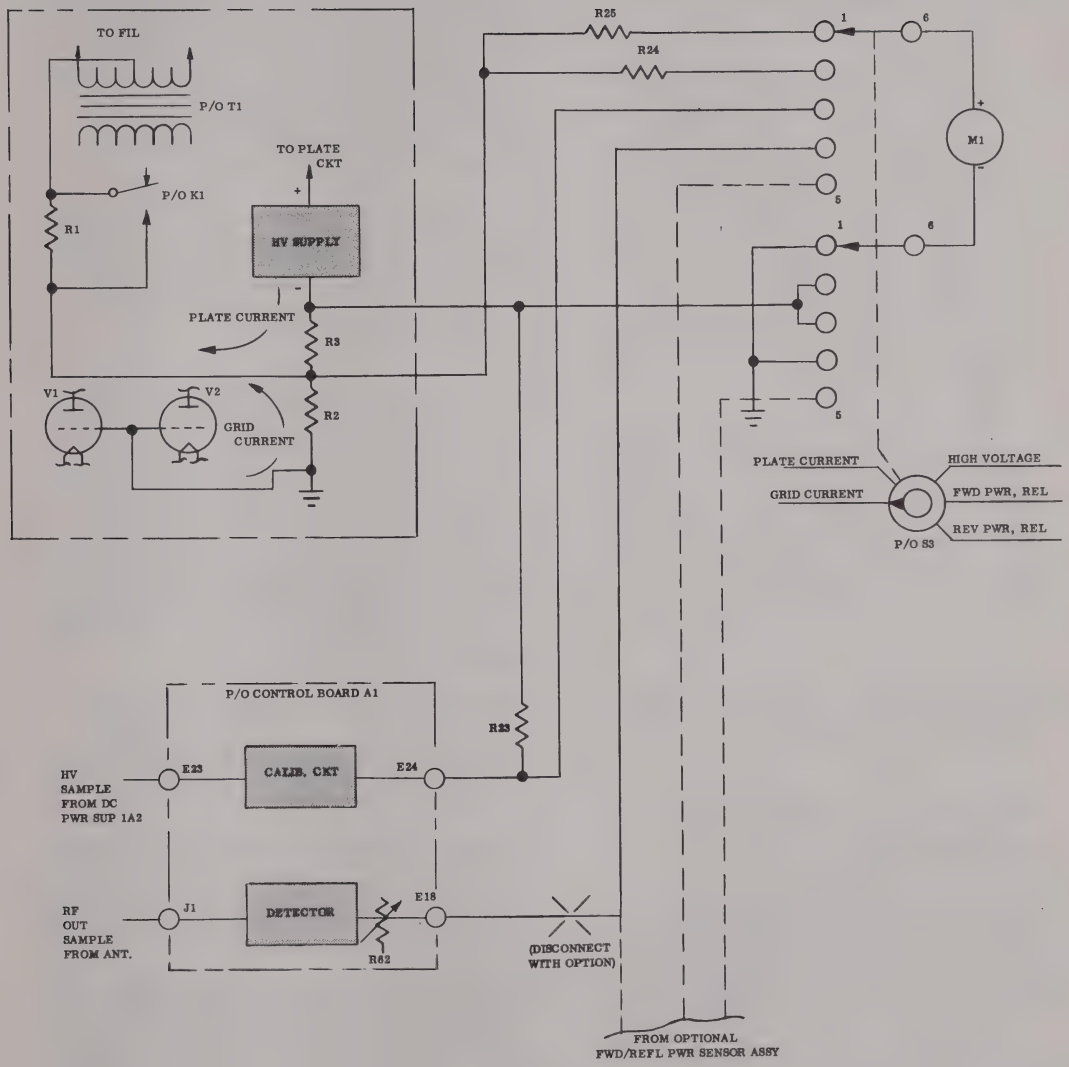


Figure 4-5. Meter Circuit, Simplified Schematic Diagram

4.9 POWER DISTRIBUTION.

Refer to figure 4-6. When primary power is applied to the Power Supply Unit, an isolation transformer provides an unswitched 115 Vac supply to the LPA. Cabinet interlock switches open the 115 Vac low lead if a unit is opened.

Assuming that all interlocks are closed, 115 Vac hot is switched on by LPA ON/OFF switch S2. One leg of the 115 Vac hot line is applied through F3 to blower B2. The other 115 Vac hot leg is connected through air vane switch S4 as follows. When proper air flow is sensed, 115 Vac is applied through F1 to the contactor coil in the Power Supply. That, in turn, causes general power to be applied, including high voltage and primary power for T1 in the LPA. When air flow is low or non-existent, 115 Vac is not applied to the contactor and filament and plate power cannot be turned on. Instead, 115 Vac is applied to the lamp flasher circuit in the Control Board, which causes the TRANSMIT lamp to flash.

LPA power transformer T1 provides power for filaments of V1 and V2, 12 Vac for Control Board power, and 24 Vac for powering all other circuits. Rectified +12 Vdc (unregulated) from the Control Board powers output relay A7K1; and through contacts of A7K1, it powers RECEIVE lamp DS11 when unkeyed and relay K1 when keyed. Regulated +12 Vdc from the Control Board powers CHANNEL lamps DS1-DS10 and an output from the LPA for optional use, named "+KW ON, 0 KW OFF".

Optional inputs to the LPA are routed to the Power Supply to allow remote turn-on/turn-off. Chapter 17 of this manual provides information on those connections.

4.10 CONTROL BOARD ASSEMBLY 1A1A1.

4.10.1 Power Supply Circuit.

The power supply circuit consists of two sections. The first, consisting of a half-wave rectifier and filter, provides +12 Vdc unregulated for external use. The second, consisting of a half-wave rectifier, filter, and a conventional regulator circuit (Q1-Q5), provides regulated +12 Vdc for internal and external use.

4.10.2 Power Control Circuit.

The power control circuit functions in conjunction with a remote gain controlled stage in the exciter to limit the exciter drive signal to a safe level for the LPA.

Channel gain controls R71-R80 each set the exciter drive level required for an individual channel to the level required to obtain full LPA output. When the corresponding channel line is grounded, the channel gain control loads down the "bottom" of a voltage divider circuit consisting of R87/R88/CR26-35/R71-80. This action results in a different set dc level applied to the emitter of Q19 for each channel, depending on adjustment during tuning of the LPA; and therefore, it results in a specific Q19 collector output for each channel at J3. This dc level is routed back to the exciter, where it sets the threshold of the exciter's peak power control (PPC) circuits.

As a safeguard against driving the LPA to excessive plate current levels during tuning or malfunction, a plate current sample is monitored; and it may result in lowering the normal ppc threshold set by Q19 and the channel gain controls. This occurs in the following manner.

The plate current sample is picked off 2500 Vdc return resistor R3 on the main frame and is applied to the Control Board at terminal E20. Terminal E20 connects the plate current sample to the base of inverter transistor Q18. Potentiometer R66 sets the peak plate current threshold by adjusting the bias at the base of Q18 at a level such that any negative current peaks between 0-10 Vdc will cause Q18 to conduct. When the plate current exceeds its nominal value, this negative going signal causes transistor Q18 to conduct and apply a positive signal through connector J3 to the RF Amplifier Board in the exciter, indicating a cutback is required.

4.10.3 Meter Circuit.

Two branches of the meter circuit are located on the Control Board; the circuits for FWD PWR, REL and HIGH VOLTAGE meter switch positions.

An output rf voltage sample from the antenna side of the rf power amplifier output network is applied to J1 on the Control Board. This sample signal is detected and filtered and applied through meter calibration potentiometer R62 to the meter switch on the front panel.

A high voltage sample is taken from the Power Supply Unit and fed through the LPA main frame to E23 on the Control Board. This sample is applied through a calibration circuit to the meter switch on the main frame. Note that R28 and R30 in the upper center of the diagram operate in conjunction with a shunt resistor on the main frame to act as a voltage divider for normal high voltage meter indication. CR6 and R29 form an auxiliary branch of the circuit, which feeds a calibrated positive voltage into the meter circuit

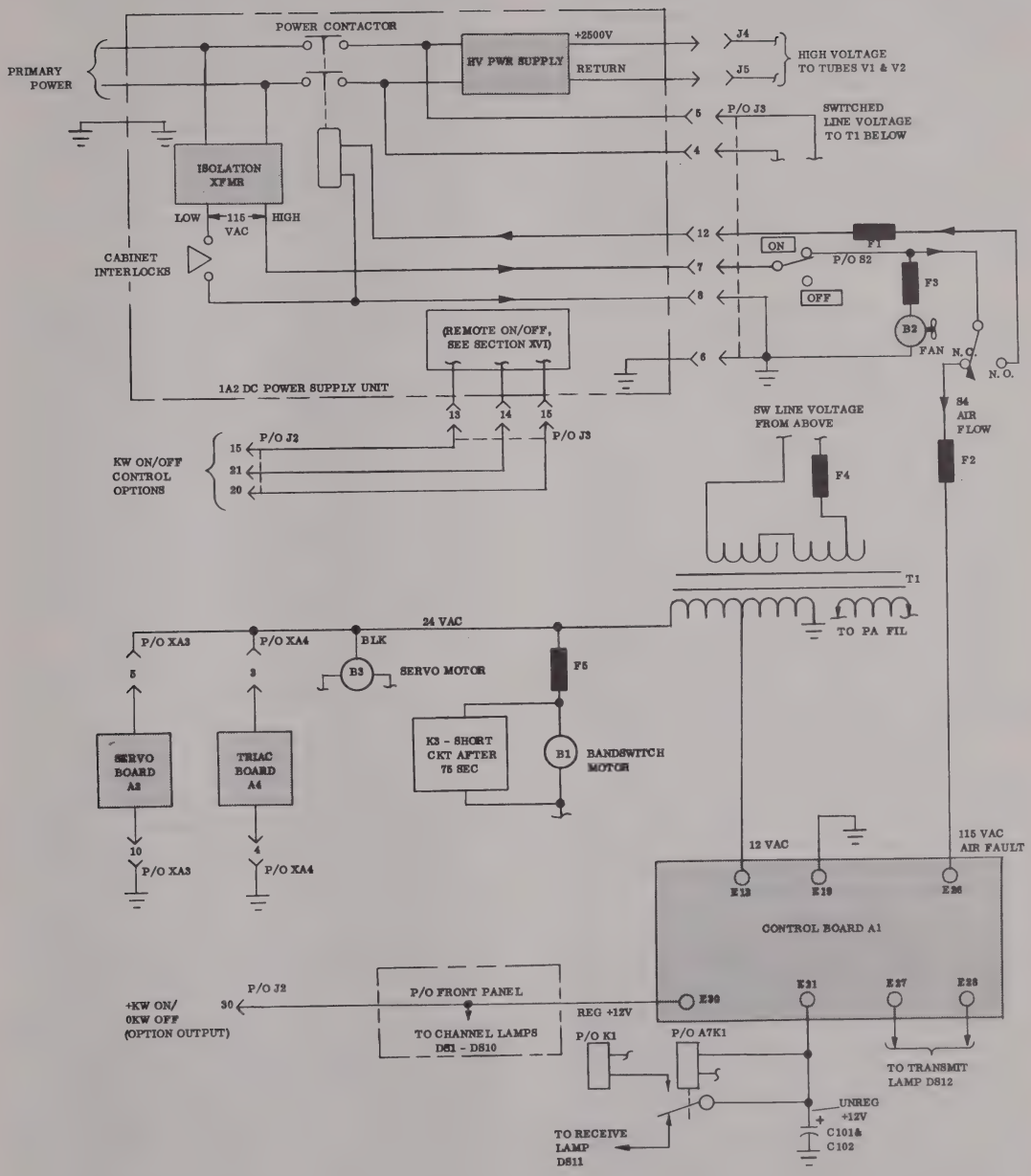


Figure 4-6. Power Distribution, Simplified Schematic Diagram

when the LPA is keyed. The circuit is calibrated with this extra voltage applied. When the LPA is unkeyed, the power supply voltage rises somewhat due to lack of loading. In this case, the extra voltage through CR6 and R29 is removed to keep the meter indication in the area of the normal indication.

4.10.4 Fault Circuit.

The fault circuit, consisting of flip-flop Q16/Q17 and associated input circuits, senses overloads of dc plate current or plate rf voltage and inhibits keying accordingly. (An additional air vane fault detector in the LPA is not a part of this circuit directly.)

A plate current sample signal from the 2500 Vdc return resistor on the main frame is applied through a low-pass filter to I_B trip set potentiometer R65. The low-pass filter removes the effects of modulation from the current sample. The variable output from R65 is applied to the "set" input of the fault flip-flop and trips the flip-flop if a current overload occurs. The adjustment of R65 is normally done such that the fault circuit trips at 900 mA or just over the current required by the channel which draws the most current.

The other fault input to the flip-flop is developed from the plate rf voltage sample at J2. The signal is detected and filtered and applied to the set input of the flip-flop to trip it if an excessively high plate rf voltage peak occurs. A dc bias from rf voltage trip set potentiometer R58 sets the level of the detector output to the proper trip point. This adjustment is normally done so the fault circuit is just on the verge of tripping at full drive on the most sensitive channel.

A pulse generator circuit (R56/C17/R55/CR19) connected to the +12 Vdc line and the input of Q17 resets the flip-flop when the LPA is initially turned on. After a fault trips the flip-flop, a reset pulse signal is generated (through C16) from the key status line when the LPA is unkeyed and then rekeyed.

The flip-flop has two outputs; lo-on-fault and hi-on-fault. The lo-on-fault signal is routed to the keying circuit to inhibit keying if a fault occurs. The hi-on-fault line is connected to the key inhibit signal part of the keying circuit, to the lamp flasher in the TRANSMIT lamp circuit, and to an external "+KW fault" line.

4.10.5 Keying Circuit.

The keying circuit consists of various interlocked stages and functions to key the LPA relays (1A1K1 and 1A1A7K1) when required and prevent keying when keying is undesirable.

With the exciter unkeyed during normal operation, the key status input is inactive, and the following stages are off: Q7, Q8, Q9, Q6, Q10, Q12, and Q20. With Q9, Q12, and Q20 off, Q11 turns on to provide a key inhibit to the exciter.

When the exciter is keyed, a key status signal is applied to Q7, thus turning on Q7, Q8, and Q9 to energize keying relays in the LPA. With Q9 on, Q11 turns off to remove the key inhibit from the exciter. A capacitor (C9) in the input circuit of Q11 provides a short time delay before the key inhibit is removed to allow relays to transfer before rf is applied. When the key status signal from the exciter is removed, keying and key inhibit stages revert to their original conditions.

Auxiliary functions alter normal operation as follows. When the Triac Board is activated for tuning during a channel change, it applies a key inhibit signal to Q20, thus turning on Q11 to provide a key inhibit to the exciter. When the ant/am tune line is activated to allow antenna coupler tuning, Q6 turns on, turning on Q10 and Q12; Q10 prevents Q9 from keying the LPA, and Q12 prevents Q11 from applying a key inhibit to the exciter; thus, the exciter can be keyed without the LPA for a low power tune signal. When a fault is detected by flip-flop Q16/Q17, Q7 is inhibited to unkey the LPA, but Q11 is also inhibited through Q12 to prevent application of a key inhibit to the exciter; this allows communications to continue uninterrupted through a direct exciter-antenna signal path (LPA bypassed by 1A1K1 and 1A1A7K1).

4.10.6 Transmit Lamp Circuit.

Lamp driver Q15 turns TRANSMIT lamp 1A1DS12 on and off in response to either of two input signals at its base. The primary mode of operation is turned on by a key signal from inverter Q8 when the LPA is keyed. The secondary mode of operation is during an LPA fault, in which case, transmit lamp flasher Q13/Q14 applies an alternating on/off signal to Q15 to flash the TRANSMIT lamp.

The base of Q14 is normally grounded through CR17 when no fault exists. The supply for the lamp is normally +12 Vdc through CR12, and the supply for Q13/Q14 is normally +12 Vdc through CR15. If a plate current or plate rf voltage fault trips the fault circuit, Q17 removes the ground from CR17 and allows Q13/Q14 to operate as an astable multivibrator to flash the TRANSMIT lamp. Since the fault circuit also unkeys the LPA, the normal steady key input to Q15 is removed and substituted by the alternating input from Q14.

When the air vane switch (1A1S4) detects a loss of air, normal power to the LPA is removed, thus removing +12 Vdc from all control circuits. The air vane switch supplies 115 Vac, in this case, to E26

to flash the TRANSMIT lamp. The 115 Vac is rectified by CR11 and reduced by voltage divider R39-R44 to provide dc power through CR13 for the lamp and through CR14 for the flasher circuit. CR12 and CR15 isolate this dc from the normal +12 Vdc lines on the Control Board. Since +12 Vdc is removed from the fault flip-flop, CR17 at Q14 base is ungrounded, and the lamp flasher runs.

4.11 MATRIX BOARD ASSEMBLY 1A1A2.

Refer to figure 8-2 during the following detailed discussion.

The rf input and output networks of the LPA are bandswitched in eleven bands to cover various frequency ranges. Input control lines from the exciter indicate channel information. The Matrix Board converts channel information to band information for use by the bandswitch circuits. In addition, the Matrix Board indicates to the normally inactive tuning circuits in the Servo and Triac Boards when a channel is changed so those boards can respond.

Refer to the schematic diagram. The major part of the Matrix Board Assembly is a matrix connection facility to allow each incoming channel line (left side) to be connected to an output band control line (bottom). Isolation diodes prevent cross connection between two or more channel lines connected to one band line.

Example jumpers are included on the schematic. Those shown would be used to make channel 9 operate on band 4 and channels 2 and 6 operate on band 10.

The secondary function of providing a channel-change ground pulse to the Triac Board when a channel is selected is performed by the additional diodes and R-C networks connected to the channel input lines. The capacitors generate a pulse when the line is first grounded, and then the resistor discharges the capacitor. The net effect on the output at terminal 11 is almost a hard ground when the new channel line is first grounded by the exciter and, then, a relatively high impedance once the capacitor is fully charged.

4.12 SERVO BOARD ASSEMBLY 1A1A3.

Refer to figure 9-2 during the following detailed circuit discussion.

The function of the Servo Board is to compare the voltage of the variable capacitor follower potentiometer with that of the associated channel tuning control potentiometer and to produce command signals for the Triac Board, which in turn drives bi-directional servo motor 1A1B3 for inductor 1A1L18. The signals generated by the servo amplifier are such that the motor is driven until voltages of the follower potentiometer and the channel tuning control potentiometer are equal.

Potentiometers R21 through R30 are the channel tuning controls for channels 1 through 10 respectively. The voltage appearing at the wiper of one of these controls is applied to input pin 1 of differential amplifier U1 by one of the series gate transistors Q12 through Q21. The appropriate series gate is turned on by a ground appearing on one of the channel command lines; contacts 13 through 22 on the printed circuit board.

The other input, pin 5, of differential amplifier U1 is connected to the wiper of the servo motor follower potentiometer through contact 3 of the pcb. It should be noted that the follower potentiometer is placed in parallel with the channel tuning controls through contacts 11 and 12 of the pcb. Whenever the voltages applied to the two inputs of differential amplifier U1 are unequal, an unbalanced state exists.

If the follower potentiometer voltage is low with respect to the command voltage, pin 6 of U1 will become high with respect to pin 8. If the command voltage is the lowest, pin 8 of U1 will become high. If both the command and the follower voltages are equal, pins 6 and 8 of U1 become equal at a potential which is determined by bias network R1 through R3. Variable resistor R2 provides an adjustment of the balanced output potential of U1 at pins 6 and 8, such that transistors Q1 and Q3 do not conduct. This is a "dead zone" adjustment which will be discussed later. When U1 is unbalanced, either Q1 or Q3 conducts.

As transistor Q1 starts to conduct, the emitter current is amplified by transistor Q2, which conducts more heavily. Transistor Q2, in turn, causes transistor Q5 to conduct, producing an "on" signal output at contact 9. Transistors Q3 and Q4 similarly monitor the other output of U1 and produce an "on" signal output. Thus, if differential amplifier U1 is unbalanced in either direction, an "on" signal output is produced.

If the unbalance is in such a direction as to cause transistor Q4 to conduct, transistor Q7 is turned on, causing a "max" motor command output. An unbalance in the other direction would not cause transistor Q4 or Q7 to conduct, which results in a "min" command output.

Because of the cascade connection of transistor pairs Q1-Q2 and Q3-Q4, there is considerable current gain, and the circuit controlling motor "on" and "max-min" is very sensitive to unbalance of the differential amplifier. A positional accuracy of approximately ±5°

of motor shaft rotation can be achieved. The collector outputs of either transistor Q1 or Q3 alone is not quite so sensitive, since the gain of only one transistor is involved. These collector outputs are used to activate transistor Q6 of the "slow/fast" circuit. Thus, when the elements are positioned to within 30° of the desired location, the collector output of either transistor Q1 or Q3 is just not sufficient to turn transistor Q6 on so that a "slow" command is generated. Any error greater than 30° causes enough current to turn on Q6, and a "fast" command is generated. All the motor command signals generated by the Servo Board are applied to the Triac Board described in subsequent paragraphs.

Transistors Q8 through Q11 make up a series-pass regulated power supply for the Servo Board. 24 Vac is applied to contact 5 of the pcb, half wave rectified by CR5, and then applied to the regulator.

Potentiometer R2 adjusts the "dead zone" of the Servo Board. A cw rotation of this resistor decreases the dead zone. If this control is adjusted too far cw, the servo motor will chatter or oscillate. If the control is adjusted too far ccw, the positional accuracy of the servo system will not be adequate. The control should be adjusted until the servo oscillates and then backed off until a "dead zone" of about ± 5° is observed.

A ground applied to contact 2 of the Servo Board shorts voltage reference zener diode VR2 to ground. When VR2 is grounded, the dc output of the regulator is zero, and the Servo Board is thereby disabled. The ground on contact 2 is called "shut down". The "shut down" command comes from the Triac Board, and is used to disable the Servo Board after all motors have come to rest.

4.13 TRIAC BOARD ASSEMBLY 1A1A4.

Refer to figure 10-2 during the following detailed circuit discussion.

The prime function of the Triac Board is to switch ac power to the bandswitch motor triac and to the bidirectional servo motor. Power to the servo motor is switched in response to command signals generated by the Servo Board. Power to the bandswitch motor triac is switched in response to the output of the open-seeking bandswitch wafer. The Triac Board consists of control circuits and triacs, which are used as ac semiconductor switches. Refer to the schematic diagram.

The Triac control circuits utilize unregulated dc voltage furnished by rectifier diode CR1 and capacitor C1. Triacs Q9 and Q10 are connected to the servo motor through limit switches.

Assume that the Servo Board commands that the servo motor should run fast, in a "cw" direction. Grounds are therefore applied to contacts 13 and 14 of the Triac Board.

Transistor Q8 of the Triac Board, is a "steering" driver for triacs Q9 and Q10. A ground (fast) signal on contact 13 of the Triac Board causes driver amplifier transistors Q2 and Q3 to conduct. The resulting current through R7 is therefore applied both to the base of Q8 and to the gate of triac Q9 (through the external limit switch). The current into the gate of triac Q9 causes it to conduct and drive its associated servo motor in the "cw" direction.

As stated above, steering transistor Q8 was turned on by the current flowing through R7. Current also flows through R8 but is shunted to ground through Q8. If, however, a ground was placed on contact 11 of the Triac Board, the drive to both Q8 and triac Q9 would be shunted to ground. The current through R8 would now go through the external limit switch back to the gate of triac Q10 (contact 8 of the Triac Board). Triac Q10 would therefore switch on, causing the servo motor to turn "ccw".

Thus, if steering transistor Q8 is held off, the motor drives "ccw"; if Q8 is on, the motor drives "cw". Steering transistor Q8 is held off by a ground applied to contact 11 and held on if a ground is not applied to contact 11. To achieve this steering control, the "cw-ccw" command from the Servo Amplifier is connected to contact 11 of the Triac Board.

The above discussion describes steering of a servo motor in the "fast" mode. Operation in the "slow" mode is initiated by removing the "fast" command (gnd) on contact 13, while leaving an "on" command (gnd) on contact 14. The ground on contact 14 is applied to the emitter of Q1, which then enables Q1 to conduct whenever a signal is applied to its base. The base of Q1 is driven by the half wave ac signal rectified by diode CR2. Since Q1 is enabled by the "on" command, it conducts at a 60 Hz rate and in turn causes driver amplifier transistors Q2 and Q3 to turn off and on at a 60 Hz rate.

As described above, Q2/Q3 supplies drive current to triacs Q9 and Q10 and steering transistor Q8. Steering is accomplished exactly as described for "fast", except that now drive is supplied to the triacs only during the positive half cycles of the ac sine wave. In effect, the conducting triac is driven only one half the time; and the resultant power delivered to the servo motor is one half of what it was during the "fast" mode. The motor actually travels at less than half speed due to saturation effects of the motor stator laminations.

Bandswitch motor triac 1A1Q1 (on main frame) is turned on simply by grounding contact 6 of the Triac Board. In the SR-110 mainframe wiring, pin 6 is jumpered to pin 29. A ground on the band-command line from the Matrix Board is applied to one contact of an open-seeking bandswitch wafer. If the bandswitch is not already set to the commanded band, that ground is carried through one or more pickoff lines connected from three contacts of the bandswitch wafer to pins 26, 27, and 28 of the Triac Board. Resistors R38-R44 provide an "or" connection, and the resultant ground at pin 29 is applied to pin 6 to turn on the bandswitch triac. When the open-seeking switch wafer is satisfied, ground is removed from all three pickoff lines; and the signal at pin 29 rises to a predetermined positive level.

When ground is applied to pin 6, Q4 is enabled, Q5 and Q6 turn on, and a positive signal is applied to the gate of bandswitch triac 1A1Q1. Triac 1A1Q1 turns on, and ac power is applied to the bandswitch motor. When ground is removed from pin 6, the transistors and the triac turn off.

The remaining components of the Triac board perform control functions as follows.

a. The servo motor circuit is disabled whenever the bandswitch motor is running.

b. As soon as the bandswitch motor stops running, the servo motor is enabled.

c. As soon as both motors come to rest, the motors are disabled until a new channel change command is received.

d. A "motor run" signal is produced which signifies whenever any motor is running. This signal is used to inhibit the exciter until all motors are stopped (key inhibit).

When both motors are at rest, bias circuit R22 and VR1 keeps transistor Q12 on, which in turn places a ground on contact 15 of the Triac Board. This is the "power shut down" line which shuts off the series dc regulator in the Servo Board.

The functions of this board are initiated by a channel change which produces a "channel change" command on contact 1 of the Triac Board. (This command is generated by the Matrix Board.) A negative going pulse on this contact is coupled to the base of Q12 and momentarily turns off this transistor. When Q12 turns off, the ground on contact 15 is removed and the servo amplifiers are enabled. When the Servo Board is enabled and a servo position error exists, Q12 is held off by the "servo on" command appearing at contact 14. As soon as the servo motor has reached the desired position, the ground is removed from contact 14, and Q12 returns to the "on" state and disables the Servo Board.

If, when the channel is changed, the new channel requires a new position of the bandswitch, a ground is applied to contact 6, and a negative pulse appears on contact 1 of the Triac Board. The servo motor would now run except for the fact that, as long as bandswitch drivers Q5/Q6 are on, triac driver Q2-Q3 is held off by diode CR4. As soon as the bandswitch motor stops, triac driver Q2-Q3 is released, and the servo motor runs.

As long as the Servo Board maintains a "motor on" command at contact 14 of the Triac Board, diode CR6 keeps the positive bias off Q12 so that the Servo Board remains enabled. As soon as the "motor on" signal is removed, the bias on Q12 is released, Q12 turns on, and the Servo Board is disabled until the next band change command.

The "key inhibit" or "motor running" signal is generated by transistor Q13. If either the bandswitch circuit or the Servo circuit is activated, transistor Q13 is turned on by signals at either R26 or R25. When Q13 is on, a ground is applied back to the Control Board, which prevents rf transmission.

4.14 POWER SUPPLY UNIT 2.

Refer to figure 11-2 during the following detailed circuit discussions.

Primary power of 115 or 230 Vac, either single-phase or one leg (single-phase) of a three-phase source, is connected to terminals 1 and 2 of TB1. Safety ground is connected to TB1-3. With front panel PA CIRCUIT BREAKER CB1-CB2 closed, power is applied through line filter FL1 to contactor K1 and transformer T2.

T2 provides 115 Vac for the fan in the LPA and for the coil of contactor K1. The fan in the LPA is activated at J3-7 and 8 when all cabinet interlock switches are closed. Contactor K1 is activated (J3-8 and 12) when an external loop in the LPA, consisting of the air vane switch and the ON/OFF switch, is closed. If air flow is insufficient, the air vane switch prevents contactor K1 from activating.

When contactor K1 closes, high voltage for the LPA tubes is developed through T1, block rectifier CR1, and choke input filter L1/C1. Taps on T1 allow high voltage to be maintained at a proper level if the line voltage is high or low. R1 is a bleeder resistor. R2 and R3 provide a high voltage sample for the LPA meter circuit by operating in conjunction with R1 to act as a 200:1 voltage divider. R4 provides a soft ground on the B- line to allow the B- line to be safely used as a return in control circuits on the Control Board and in the meter circuit without floating far above ground. C2 and C3 are rf bypasses.

CHAPTER 5

MAINTENANCE

TABLE OF CONTENTS

Paragraph	Title
5.1	Periodic Maintenance
5.2	Fuse and Lamp Replacement
5.3	Test Equipment
5.4	Output Network Alignment
5.5	Input Network Alignment
5.6	Power Meter Adjustment
5.7	RF Voltage Trip Adjustment
5.8	Plate Current Trip Adjustment
5.9	Dead Zone Adjustment
5.10	Bandswitch Mechanical Alignment
5.11	Rechanneling
Figure	**Title**
5-1	Alignment of Bandswitch Stator and Rotor Contacts

5.1 PERIODIC MAINTENANCE.

5.1.1 General.

The LPA is designed to require a minimum amount of preventive maintenance. The following paragraphs describe items which should be given occasional attention. The exact schedule for performance of these maintenance items depends on usage and environmental factors.

5.1.2 Air Filter Cleaning.

Periodically, the air filter should be removed and cleaned with soap and water and/or compressed air. Access is gained by removing the four screws securing the perforated panel to the cabinet. The filter, located behind the perforated panel, can be removed by removing its two retaining screws, which secure it to the chassis.

5.1.3 Fan Motor.

Periodically, light machine oil should be applied to the fan motor bearing ports. The oil ports are located on the front and rear of the motor.

5.1.4 Bandswitch Contacts and Variable Inductor.

These items are subjected to wear each time a channel change occurs. The life of these components may be extended considerably by proper lubrication. Inspection and lubrication if necessary should be done every three months of continuous operation. Any high quality lubricant formulated for switch contacts may be used. G. C. Electronics distributes a compound which is satisfactory: "Luberex No. 1206".

CAUTION

All lubricants should be considered conductive and applied accordingly. Greases and oils become contaminated with fine particles of metal and other types of conductive dust. Use sparingly, and apply only to the switch contact or bearing area to be lubricated. Lubricants applied to ceramic structures will eventually become contaminated and cause arcing. Do not use spray-type applicators.

Bandswitch wafers S1-A and S1-B are housed in the cathode plenum, which is underneath the LPA chassis. For access, remove bottom cover of plenum

and remove the input coil assembly, which contains wafers A and B. Lubricate both wafers, and reassemble the cathode plenum.

The high-voltage portions of the bandswitch are inside the top LPA compartment.

WARNING

Ensure that all power is removed and short out tube plate caps before working inside this compartment. It normally contains 2500 Vdc.

Remove top compartment cover. Apply lubricant to each stator contact and to the rotor slip-ring contact of each wafer, using a fine-tipped brush. Be sure that both the top and bottom contact surfaces of each contact are lubricated.

Variable coil L18 is also located in the top compartment. Remove top and left side covers for access. Lubricate L18 as follows.

a. Apply a drop of light machine oil to the bushing-type bearing, which is mounted in the ceramic plate at each end of the coil.

b. Apply contact lubricant to the spring contacts on the rotor shaft at both ends of the coil.

c. Apply contact lubricant to the shaft that supports the rolling contact and to the contact surface. Be careful not to allow grease to contaminate the ceramic cylinder.

5.2 FUSE AND LAMP REPLACEMENT.

All of the fuses are located in the LPA Unit and function as follows. In addition, the Power Supply Unit has a main power circuit breaker.

FUSE	CIRCUIT PROTECTED	VALUE	P/N
1F1	115 Vac Contactor Coil	2.5 Amp slo-blo	F20250
1F2	115 Vac Alarm to Control Board	2.5 Amp slo-blo	F20250
1F3	115 Vac to Fan(s)	2.5 Amp slo-blo	F20250
1F4	Filament Transformer	5 Amp slo-blo	F20500
1F5	Bandswitch Motor	5 Amp slo-blo	F20500

Indicator light assemblies use replacement lamp P/N DS1003. Burned out lamps may be replaced as follows.

a. Remove the lens from the assembly by unscrewing it in a ccw direction.

b. With a small pair of needle-nose pliers, grasp the head of the lamp, being careful not to break it, and pull it straight out.

c. Insert the replacement lamp, and replace the lens.

5.3 TEST EQUIPMENT.

The following test equipment or equivalent substitutes may be required for servicing.

a. 50Ω, 1 kW RF Dummy Load.

b. VSWR Bridge or Reflected Power Meter (low-cost unit is sufficient for general usage).

c. Peak Reading VTVM, HP-410C, with HP-11042A T-probe Adapter.

d. VOM, Simpson 260.

e. Oscilloscope, 15 MHz or greater (optional).

f. Audio Signal Generator (optional).

5.4 OUTPUT NETWORK ALIGNMENT.

If some type of repair requires tuning of the output network for any channel, perform the following procedure.

a. Connect a 50Ω, 1 kW rf dummy load to the output of the LPA.

b. Remove four screws securing the blank perforated panel to the cabinet, and set the panel aside.

c. Set LPA MULTIMETER switch to FWD PWR, REL.

d. Defeat interlock switch behind perforated panel.

e. Turn on PA CIRCUIT BREAKER and ON/OFF switch.

f. Set exciter to AM and to desired channel. If am mode is not available in some channels, an audio signal generator can be used to generate a low power usb signal for tuning.

g. Locate Triac Board A4, and set its "tune/operate" switch to "tune".

CAUTION

In "tune" position, this switch defeats protective circuitry. Do not channel LPA with rf drive applied in "tune" mode.

h. Refer to Chapter 9, and locate channel tune control for desired channel (A3R21-R30) on Servo Board.

i. Key exciter, and adjust appropriate channel tune control for maximum output indication.

NOTE

If L18 is tuned to an end stop, the limit switch will initiate key inhibit, which will prevent operation except in the Tune condition. Make sure that tuning is not at end of range.

j. Unkey set. Repeat procedure for other channels if necessary; otherwise, restore normal operation, including resetting Triac Board "tune/operate" switch to "operate".

5.5 INPUT NETWORK ALIGNMENT.

Input network coils L1-L11 (under LPA chassis) are peaked at the factory for the arithmetic center of each band. As such, they cover their entire bands with low vswr presented to the exciter. Normally, they do not require tuning, as tuning is rather broad and non-critical.

If some repair is made which might affect these coils, a simple check can be made to determine if tuning is necessary. Insert a vswr bridge or directional power meter in the rf drive line from the exciter. Check each channel which falls in the band in question to determine if the vswr presented to the exciter is less than 2 to 1. The am carrier signal can be used for this test.

If necessary, the coil for a particular band may be retuned to bring the vswr down to 2 to 1 for all channels in the band. However, this should not be done without sufficient cause, since the proper alignment is done at band center and your channels are probably not at the ideal alignment frequencies. Thus, retuning is likely to offset the band alignment and spoil the band tuning for future channel reassignments.

5.6 POWER METER ADJUSTMENT.

Adjustment of the MULTIMETER for the FWD PWR, REL function is relatively easy. This function normally indicates relative rf output voltage detected in the Control Board. (If the optional forward/reflected power meter is supplied, this circuit is not used, and this procedure is not applicable.)

The indication relates to voltage, not power; and as such, if the impedance of the antenna is different from 50Ω, the indication cannot be mentally correlated with power output in the simple manner normally used. Also, it should be noted that the indication varies slightly with frequency, although this is of insignificant consequence in its use as a relative output indicator.

The procedure which follows adjusts the meter to provide full scale indication for 1 kW into a 50Ω load at mid-frequency. However, since the meter is intended as an operating aid, you may prefer to calibrate it differently to suit the operator. As an example, if used exclusively on voice, the operator might like to be able to talk the meter up to full scale. This will not occur with normal calibration except with a single-tone input signal.

a. Set up for operation with a single-tone input (cw or fsk operation or an audio signal generator into the MICROPHONE connector). (See test setup illustration in Figure 2-6.)

b. Remove perforated panel and defeat interlock to allow operation with Control Board exposed.

c. Connect LPA rf output to dummy load and HP-410C or similar rf voltmeter through T-probe adapter.

d. Select a channel near 10-15 MHz (or center of your operating frequencies).

e. Key set, and adjust drive for 225 Vrms output indication on rf voltmeter.

f. Adjust meter calibration potentiometer R62 on Control Board for full-scale indication.

g. Unkey, and restore system to normal operating configuration.

5.7 RF VOLTAGE TRIP ADJUSTMENT.

The rf voltage fault detector senses when the rf voltage at the plate circuit increases beyond a normal

level. Such could occur if the load impedance rises because of antenna system trouble, or if the drive level is not limited, or if an oscillation occurs, etc. The circuit is adjusted to trip just beyond the highest level normally found at the plate circuit, as follows.

a. Set up for single-tone operation with Control Board exposed and rf voltmeter and dummy load connected, as in paragraph 5.6.

b. Determine the channel requiring the least plate current at 1000 Watts (225 Vrms) output. Continue using that channel for adjustment.

c. Drive the LPA to 225 Vrms across the dummy load (1 kW).

d. Adjust rf voltage trip set potentiometer R58 on the Control Board to the point at which the fault circuit just trips and the TRANSMIT lamp flashes. Then, rotate R58 back approximately 30° in the opposite direction (to trip at higher level).

e. Rekey the set and key on other channels to verify that fault circuit will not trip at 1 kW. A fine adjustment upward may be necessary to ensure that the circuit is not set on the threshold.

f. Unkey, and restore system to normal operation.

5.8 PLATE CURRENT TRIP ADJUSTMENT.

The plate current fault detector is normally set up to trip just above the plate current level for the channel requiring the greatest current for full power output. Such a fault could occur if the load impedance is too low, the LPA is tuned off resonance, or a component malfunction draws excessive current.

a. Set up for single-tone operation with Control Board exposed and rf voltmeters and dummy load connected, as in paragraph 5.6.

b. Determine the channel requiring the most plate current (with MULTIMETER on LPA) at full output.

c. Set drive level for 225 Vrms output on rf voltmeter (1000 Watts average). If necessary to reach 1000 Watts, temporarily disconnect ppc cable from exciter rear panel.

d. Adjust I_B trip set potentiometer R65 on the Control Board just to the point at which the fault circuit trips. Then, rotate control back 30-40° in the opposite direction (to trip at higher level).

5.9 DEAD ZONE ADJUSTMENT.

The dead zone adjust potentiometer, R2, should be adjusted for a dead zone of about 5° in motor rotation to provide as much tuning accuracy as is possible without causing oscillation due to automatic correction for overtravel. Following is a simplified procedure for adjusting R2, while avoiding exposure to high voltage.

a. Turn off PA CIRCUIT BREAKER and ON/OFF switch on LPA.

b. Remove perforated LPA panel, and defeat interlock switch behind panel.

c. Remove cover from pc board housing box.

d. Remove rear LPA perforated panel (if one is used).

e. Locate ac motor capacitor 1A1C108 under rear or LPA chassis. Connect multimeter, set to measure 50 Vac, between capacitor terminals. Check to ensure that terminals are not shorted, and check to ensure that connection is not made between two lugs of same terminal. The meter will be used to indicate when motor is running.

f. Set up for operation; and turn on PA CIRCUIT BREAKER, LPA panel ON/OFF switch, and exciter.

g. Set Triac Board "tune/operate" switch to "tune".

CAUTION

In the "tune" position, protective circuits are defeated. Do not key set while changing channels.

h. Select a channel, and locate the corresponding channel tune potentiometer on the Servo Board.

i. Set channel tune potentiometer for desired channel so slot is oriented directly up and down.

j. Turn channel tune potentiometer back and forth 45° (1/8 turn) several times. Servo motor should not turn (as indicated on multimeter). A slight further rotation of the channel tune potentiometer should cause motor to advance.

NOTE

Object of adjustment of R2 will be to create a dead zone equivalent to 45° of channel tune po-

tentiometer change. If R2 is set too far ccw, dead zone will be too large, and tuning will not be accurate due to difference in tuning when coil approaches from opposite directions. If R2 is too far cw, dead zone will be too narrow, and the motor will slowly oscillate in attempt to correct for small inherent overtravel after turnoff.

k. To change dead zone width, locate and adjust R2 with a screwdriver. Then, repeat 45° test with channel tune potentiometer.

l. When adjustment is done satisfactorily, check operation of each channel to ensure that no motor oscillation occurs.

m. Restore normal operation, except do not reinstall covers. Disconnect multimeter, and reset Triac Board "tune/operate" switch to "tune".

n. Perform channel tuning procedure in paragraph 5.4 to compensate for various effects of this procedure.

5.10 MECHANICAL ALIGNMENT OF BANDSWITCH S1.

Rotary bandswitch S1 is factory aligned for proper mating of rotors and stators after bandswitch motor B1 comes to rest. To ensure proper alignment after extended use or after repairs, proceed as follows.

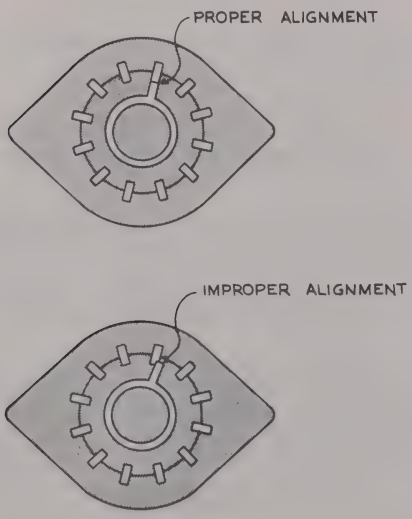


Figure 5-1. Alignment of Bandswitch Stator and Rotor Contacts

WARNING

Lethal voltages exist within the amplifier plenum. Ensure that PA CIRCUIT BREAKER on Power Supply and ON/OFF switch on LPA are in the OFF position, and short out tube plate caps prior to touching any components.

a. Perform procedure in paragraph 5.11.2 steps a — d.

b. Defeat front perforated panel interlock switch.

c. Remove screws securing top LPA cover, and remove the cover.

d. Turn on Power Supply PA CIRCUIT BREAKER and LPA ON/OFF switch.

e. Channel the exciter through each channel (without rf drive). When bandswitch stops in each channel, observe that stator and rotor contacts are properly aligned, as shown in figure 5-1. If misaligned, proceed as follows.

f. Turn off PA CIRCUIT BREAKER and LPA ON/OFF switch. (SHORT PLATES AS STATED ABOVE!)

g. Loosen locking nut on S1 stator/rotor adjustment screw.

h. Rotate and lock adjustment screw, and repeat steps d — h until proper alignment is obtained.

i. When alignment appears correct, check to ensure that locking nut is secure; then, check all channels for satisfactory alignment.

j. Restore LPA to normal operating condition.

5.11 RECHANNELING.

5.11.1 General.

If the SR-110 was ordered without channel information or if one or more channels are to be reassigned to new frequencies, complete programming and tuning of the LPA is required for the channels involved. Paragraphs 5.11.2 — 5.11.4 provide complete procedures for setting up a new channel in the LPA.

As a guide, the following tasks must be accomplished when changing channels:

- Crystal installation, rf tuning, and ppc adjustment in the exciter per exciter instruction manual.
- Matrix Board programming: channel-band.
- Output network tuning into dummy load.
- Ppc adjustment with dummy load per instructions in Chapter 2 of this manual.
- Antenna Coupler tuning for minimum reflected power (if used) per instruction manual for coupler.
- Antenna length adjustment may be necessary if separate resonant antenna is used for each channel.

5.11.2 Preparation.

a. Set PA CIRCUIT BREAKER on Power Supply panel to OFF (down).

b. Remove four screws which secure the perforated panel to the cabinet, and remove the panel.

WARNING

High voltages exist in many areas with the LPA turned on. Appropriate precautions should be observed. No components in the upper or lower amplifier compartments should ever be touched with power on. Always turn off power and short tube plates before working in compartments.

c. Remove the two screws which secure the perforated cover on the pc board housing box, and remove the cover.

d. Disconnect antenna coaxial cable from LPA, and connect 50Ω, 1 kW dummy load to LPA output.

e. Determine the new channels to be provided, and determine if channels fall within different bands with respect to existing setup, according to information in table 4-1. If different, or if in doubt, proceed to Matrix Board programming procedure in paragraph 5.11.3. If existing programming is still correct, proceed directly with tuning procedure of paragraph 5.11.4.

5.11.3 Matrix Board Programming.

a. Remove Matrix Board A2 from the pc board housing box.

b. Using an eraser, clean all terminals to be soldered on the Matrix Board.

c. Compare present and new channel assignments with table 4-1 to determine if channel-band correlations are different, and determine channels requiring changes.

d. Refer to Matrix Board schematic diagram in Chapter 8, and make required changes in programming by installing no. 22 AWG jumper wires. Following are examples of programming.

Example 1:

If the allocated channel 9 frequency is 3.0 MHz, table 4-1 shows this to fall between 2.68 and 3.2 MHz, indicating that channel 9 must be programmed to band 4.

To program channel 9 to band 4, solder a length of no. 22 wire between board points "A" and "B" as indicated on the schematic diagram.

Example 2:

If the allocated channel 2 and channel 6 frequencies are 19 MHz and 24.5 MHz, respectively, table 4-1 shows these frequencies to fall in band 10, which covers 18 to 25 MHz.

To program channels 2 and 6, two lengths of wire are soldered on the board at points corresponding to "C", "D", and "E" as marked on the schematic diagram.

e. After completing all programming and checking it, reinstall Matrix Board A2 in the pc board housing box. Proceed with tuning procedure which follows.

5.11.4 Tuning Procedure.

a. Defeat front perforated panel interlock switch.

b. Set exciter function switch to TRANSCEIVE or PTT/CW, depending on which exciter it is. Allow a few minutes warmup time.

c. Turn on PA CIRCUIT BREAKER on Power Supply and ON/OFF switch on LPA.

d. Set exciter channel selector to channel to be tuned.

e. Set exciter mode switch to AM. If am mode is not available in some channels, an audio signal

generator can be used to generate a low power usb signal instead of carrier.

f. Set Triac Board "tune/operate" switch to "tune".

CAUTION

With the "tune/operate" switch set to "tune", protective circuitry is disabled. Do not channel set with rf applied.

g. Set LPA MULTIMETER switch to FWD PWR, REL.

h. Refer to component location and schematic diagrams in Chapter 9, and locate channel tune potentiometer for channel to be tuned (A3R21-R30) on Servo Board.

i. Key exciter, and adjust channel tune potentiometer for maximum output indication on MULTIMETER. Unkey.

NOTE

1. If tuning cannot be achieved, check to ensure correct bandswitch position.

2. If L18 is tuned to an end stop, the limit switch will initiate a key inhibit, which will prevent operation except in the Tune condition. Make sure that tuning is not at end of range.

j. Set Triac Board "tune/operate" switch to "operate".

k. Set Exciter mode selector to USB or LSB.

l. Set exciter TRANSMIT AUDIO control to the approximate vicinity of the TRANSMIT lamp (if so equipped).

m. Key the exciter, and whistle into the microphone for a sustained period. Observe that LPA MULTIMETER indicates 0.7 to 0.9 in the PLATE CURRENT position and 0.8 to 1.0 in the FWD PWR, REL position.

NOTE

The set may require "system power control" (ppc) adjustment according to procedure in Chapter 2 for your particular exciter. Since the procedure requires special test equipment setup and careful adjustments in both the LPA and exciter, disturbing the present ppc adjustment should be avoided if possible. A simple check, as just done, is usually adequate to check power control setup.

If insufficient power output is obtained, ppc may be limiting excessively. If too much current or output is obtained or if an oscilloscope test or complaints of splatter heard on a distant receiver occur, the ppc circuit may not be limiting rf drive enough and the amplifier stage may be flattopping on voice peaks.

n. After the required channel is tuned, repeat procedure for other channels or restore LPA to normal operating condition.

CHAPTER 6

LPA MAIN FRAME UNIT 1A1

REF DESIG	DESCRIPTION	PART NO.
---	POWER AMPLIFIER CHASSIS ASSEMBLY	110700
A1	Control Board Assembly	110486
A2	Matrix Board Assembly	110430
A3	Servo Board Assembly	110490
A4	Triac Board Assembly	110438
A5	Directional Coupler (optional)	110935
A6	Separate Channel Output Assembly	110415
A7	Output Relay Assembly	110420
B1	Motor, 24 Vac	B00003
B2	Motor/Fan Assembly	110837
	OR - with high altitude option	110991
B3	Motor, 24 Vac, Reversible	B00005
B4	Fan, with cord and screen (high-altitude option)	B00002
C1	Cap, mica, 1000pF, 5%, 500 Vdcw	C06102
	Cap, mica, 820pF, 5%, 500 Vdcw	C06821
C2	Cap, mica, 1000pF, 5%, 500 Vdcw	C06102
	Cap, mica, 510pF, 5%, 500 Vdcw	C06511
C3	Cap, mica, (2X) 620pF, 5%, 500 Vdcw	C06621
C4	Cap, mica, (2X) 620pF, 5%, 500 Vdcw	C06621
C5	Cap, mica, (2X) 510pF, 5%, 500 Vdcw	C06511
C6	Cap, mica, (2X) 470pF, 5%, 500 Vdcw	C06471
C7	Cap, mica, (2X) 220pF, 5%, 500 Vdcw	C05221
C8	Cap, mica, (2X) 100pF, 5%, 500 Vdcw	C05101
C9	Cap, mica, (2X) 62pF, 5%, 500 Vdcw	C05620
C10	Cap, mica, (2X) 68pF, 5%, 500 Vdcw	C05680
C11	Cap, mica, (2X) 22pF, 5%, 500 Vdcw	C05220
C12-C13	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C14-C16	Cap, cer, .01μF, 1.6 kVdcw	C00001
C17-C18	Cap, cer, barrel, 1000pF, 5kVdcw, hi-k	C00064
C19-C20	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C21	Cap, cer, barrel, 50pF, 7.5kVdcw, np0	C00061
C22	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C23	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C24	Cap, cer, barrel, 75pF, 7.5kVdcw, N750	C00062
C25	Cap, cer, barrel, 75pF, 7.5kVdcw, N750	C00062
C26	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C27-C28	Cap, cer, barrel, 75pF, 7.5kVdcw, N750	C00062
C29	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C30	Cap, cer, barrel, 100pF, 5kVdcw, N750	C00063
C31	Cap, cer, barrel, 75pF, 7.5kVdcw, N750	C00062
C32	Cap, cer, barrel, 50pF, 7.5kVdcw, np0	C00061
C33	Cap, cer, barrel, 25pF, 7.5kVdcw, np0	C00060
C34-C35	Cap, cer, barrel, 25pF, 7.5kVdcw, np0	C00060
C36	Cap, cer, barrel, 50pF, 7.5kVdcw, np0	C00061

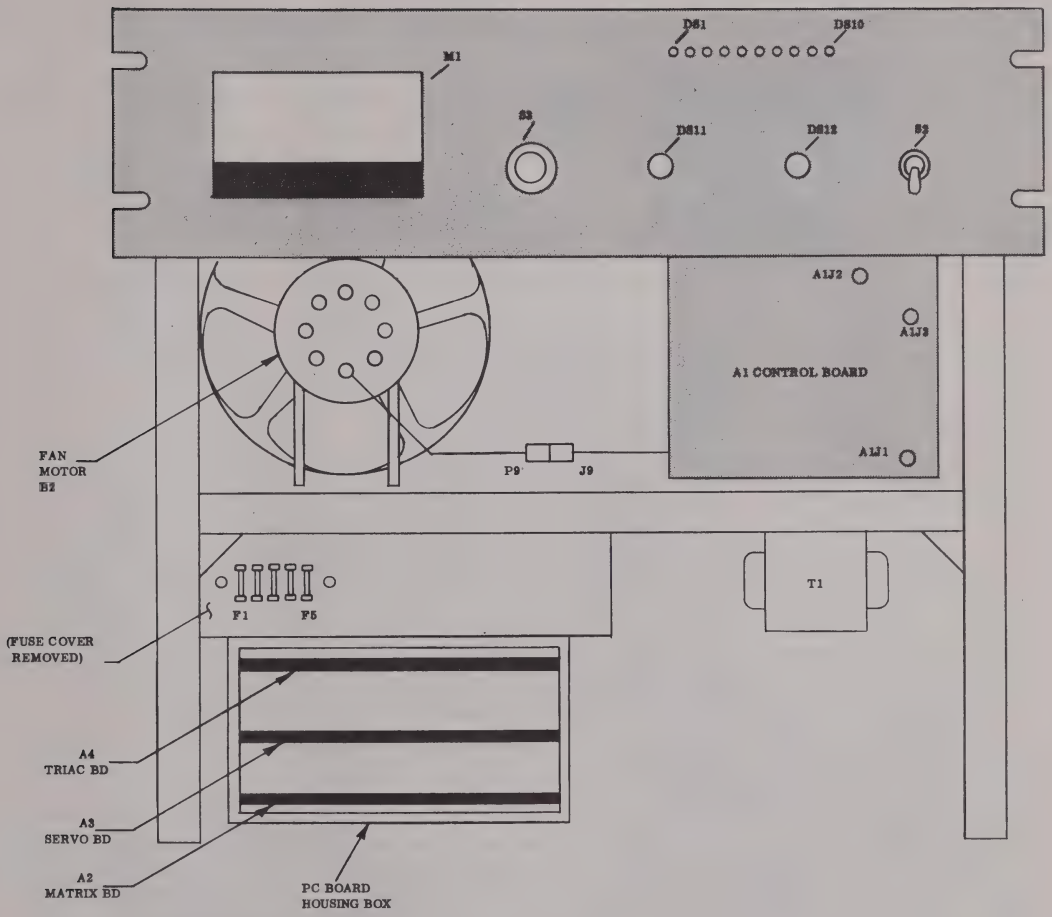
REF DESIG	DESCRIPTION	PART NO.
C37-C39	Cap, cer, barrel, 25pF, 7.5 kVdcw, np0	C00060
C40-C65	Cap, cer, 160pF, 1 kVdcw	C00034
C66	Cap, cer, 65pF, 3 kVdcw	C00032
C67-C73	Cap, cer, 160pF, 1 kVdcw	C00034
C74	Not used	---
C75-C77	Cap, cer, 160pF, 1 kVdcw	C00034
C78	Cap, cer, 100pF, 1 kVdcw	C00033
C79-C82	Cap, cer, 160pF, 1 kVdcw	C00034
C83-C91	Cap, cer, 65pF, 3 kVdcw	C00032
C92-C95	Cap, cer, 20pF, 6 kVdcw	C00031
C96	Cap, cer, barrel, 100pF, 5 kVdcw, N750	C00063
C97	Cap, cer, barrel, 50pF, 7.5 kVdcw, np0	C00061
C98	Not used	---
C99	Not used	---
C100	Cap, elect, 200μF, 150 Vdcw	C70002
C101	Cap, elect, 500μF, 50 Vdcw	C70003
C102	Cap, elect, 500μF, 50 Vdcw	C70003
C103	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C104	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C105	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C106	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C107	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C108	Cap, elect, motor start, 160μF, 120 Vac	C70006
C109	Cap, plate sample, 3pF	110716
C110	Cap, mica, 100pF, 5%, 500 Vdcw	C05111
C111	Cap, mica, 10pF, 5%, 500 Vdcw	C05100
C112	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C113	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C114	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C115	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C116	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C117	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C118	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C119	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C120	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C121	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C122	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C123	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C124	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C125	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
C126	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
C127	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
C128	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
C129	Not used	---
C130	Cap, feedthru, 2300pF	110938
C131	Cap, feedthru, 2300pF	110938
C132	Cap, feedthru, 2300pF	110938
C133	Cap, feedthru, 2300pF	110938
C134	Cap, feedthru, 2300pF	110938
C135	Cap, feedthru, 2300pF	110938
C136	Cap, feedthru, 2300pF	110938
C137	Cap, feedthru, 2300pF	110938
C138	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C139	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C140	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C141	Cap, cer, .01μF, 20%, 500 Vdcw	C10100

REF DESIG	DESCRIPTION	PART NO.
C142	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C143	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C144	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C145	Not used	---
C146	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C147	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C148	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C149	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C150	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C151	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C152	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C153	Not used	---
C154-C156	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C157-C158	Cap, mica, 15pF, 5%, 500 Vdcw	C05150
CR1	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR2	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR3	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR4	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR5	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR6	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR7	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR8	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR9	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR10	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR11	Not used	---
CR12	Not used	---
CR13	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR14	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR15	Diode, si, 1 Amp, 200V, 1N4003	CR4003
DS1	Lamp, special, 5V, 60mA	DS1003
DS2	Lamp, special, 5V, 60mA	DS1003
DS3	Lamp, special, 5V, 60mA	DS1003
DS4	Lamp, special, 5V, 60mA	DS1003
DS5	Lamp, special, 5V, 60mA	DS1003
DS6	Lamp, special, 5V, 60mA	DS1003
DS7	Lamp, special, 5V, 60mA	DS1003
DS8	Lamp, special, 5V, 60mA	DS1003
DS9	Lamp, special, 5V, 60mA	DS1003
DS10	Lamp, special, 5V, 60mA	DS1003
DS11	Lamp, special, 5V, 60mA	DS1003
DS12	Lamp, special, 5V, 60mA	DS1003
F1	Fuse, 3AG, slo-blo, 2.5 Amp	F20250
F2	Fuse, 3AG, slo-blo, 2.5 Amp	F20250
F3	Fuse, 3AG, slo-blo, 2.5 Amp	F20250
F4	Fuse, 3AG, slo-blo, 5 Amp	F20500
F5	Fuse, 3AG, slo-blo, 5 Amp	F20500
J1	Recept, BNC, UG-625 B/U	J00350
J2	Connector, 36 pin male	P00253
J3	Connector, 36 pin male	P00253
J4	Connector, recept, high voltage, black	110894
J5	Connector, recept, high voltage, red	110893
J6	Not used	---
J7	Not used	---

REF DESIG	DESCRIPTION	PART NO.
J8	Connector, 36 pin male	P00253
J9	Recept, 2 socket, in-line	J00202
J10	Not used	---
J11	Not used	---
J12	Not used	---
J13	Connector, 36 pin female	J00253
J14-J15	Recept, 2 socket, in-line	J00202
K1	Relay, 3pdt, 12 Vdc	K10010
K2	Not used	---
K3	Relay, thermal, 26V, 75 sec delay	110967
L1	Inductor, var, 2.3-4.4μH	L32008
L2	Inductor, var, 2.3-4.4μH	L32008
L3	Inductor, var, 2.3-4.4μH	L32008
L4	Inductor, var, 1.4-2.3μH	L32007
L5	Inductor, var, 1.4-2.3μH	L32007
L6	Inductor, var, 0.65-1.0μH	L32005
L7	Inductor, var, 0.65-1.0μH	L32005
L8	Inductor, var, 0.65-1.0μH	L32005
L9	Inductor, var, 0.65-1.0μH	L32005
L10	Inductor, var, 0.24-0.38μH	L32003
L11	Inductor, var, 0.24-0.38μH	L32003
L12	Inductor Assembly, cathode	110196
L13	Choke, rf, plate	110830
L14	Inductor, tapped	110944
L15	Inductor, air	110917-1
L16	Inductor, air	110917-2
L17	Inductor, air	110917-2
L18	Inductor, var, 4.4μH, 10 Amp	L32011
L19	Parasitic choke assembly	110763
L20	Parasitic choke assembly	110763
L21	Choke, rf	110830
L22	Choke, rf, 330μH	L10331
L23	Choke, rf, 330μH	L10331
L24	Choke, rf, 330μH	L10331
L25	Choke, rf, 300μH	L10331
M1	Meter, panel	110979
MP1	Knob, skirted	MP0401
MP2	Clamp, cable, adhesive	MP0700
MP3	Coupling, flexible	MP0219
MP4	Gear, spur, nylon, 1.00 pitch dia	110912
MP5	Gear, spur, nylon, 0.688 pitch dia	110913
MP6	Air filter, washable	110115
P1	Not used	---
P2	Not used	---
P3	Not used	---
P4	Not used	---
P5	Plug, 4 pin	P00200
P6	Conn, plug, banana (plastic removed)	110872
P7	Plug, BNC, UG-88/U	P00350
P8	Connector, 36 pin female	J00253
P9	Plug, in-line, 2 pin	P00202

REF DESIG	DESCRIPTION	PART NO.
P10	Not used	---
P11	Plug, phono	P00101
P12	Plug, phono	P00101
P13	Connector, 36 pin male	P00253
P14-P15	Plug, in-line, 2 pin	P00202
Q1	Triac, A01061	Q00003
R1	Res, ww, 10K, 12W	110836
R2	Res, comp, 1Ω, 5%, 1W	R401R0
R3	Res, ww, 12Ω, 12W	R90002
R4	Res, comp, 1.2K, 5%, 1/2W	R30122
R5	Not used	---
R6	Not used	---
R7	Not used	---
R8	Not used	---
R9	Not used	---
R10	Not used	---
R11	Res, comp, 150Ω, 5%, 1/2W	R30151
R12	Res, comp, 150Ω, 5%, 1/2W	R30151
R13	Res, comp, 150Ω, 5%, 1/2W	R30151
R14	Res, comp, 150Ω, 5%, 1/2W	R30151
R15	Res, comp, 150Ω, 5%, 1/2W	R30151
R16	Res, comp, 150Ω, 5%, 1/2W	R30151
R17	Res, comp, 150Ω, 5%, 1/2W	R30151
R18	Res, comp, 150Ω, 5%, 1/2W	R30151
R19	Res, comp, 150Ω, 5%, 1/2W	R30151
R20	Res, comp, 150Ω, 5%, 1/2W	R30151
R21	Not used	---
R22	Not used	---
R23	Res, comp, 6.8K, 5%, 1/4W	R20682
R24	Res, comp, 100K, 5%, 1/4W	R20104
R25	Res, comp, 1.5K, 5%, 1/2W	R20152
R26	Res, comp, 150Ω, 5%, 1/2W	R30151
R27	Res, comp, 150Ω, 5%, 1/2W	R30151
R28	Res, ww, 1Ω, 8W	R90003
R29	Pot, ww, 1K, 10-turn	R90008
S1-A	Switch wafer, 1 pole, 11 pos	S10203
S1-B	Switch wafer, phenolic	110971
S1-C,D,E,F	Switch assembly	110702
S2	Switch, toggle, dpdt	S00310
S3	Switch, rotary, special	S10007
S4	Switch, lever, light-action	S00305
S5	Switch, lever, light-action	S00305
S6	Switch, lever, light-action	S00305
T1	Transformer, filament	110815
TB1	Terminal strip, solder lug type, 5 term	TB0102
TB2	Terminal strip, solder lug type, 5 term	TB0102
TB3	Terminal strip, solder lug type, 5 term	TB0102
TB4	Terminal strip, solder lug type, 5 term	TB0102
TB5	Terminal strip, solder lug type, 2 term	TB0104
TB6	Terminal strip, solder lug type, 5 term	TB0102
TB7	Terminal strip, solder lug type, 5 term	TB0102

REF DESIG	DESCRIPTION	PART NO.
TB8	Terminal strip, solder lug type, 4 term	TB0100
TB9	Terminal strip, solder lug type, 5 term	TB0102
TB10	Terminal strip, solder lug type, 4 term	TB0100
TB11	Terminal strip, solder lug type, 2 term	TB0101
V1	Tube, electron, VT-3-500Z	V3500Z
V2	Tube, electron, VT-3-500Z	V3500Z
XA1	Not used	---
XA2	Connector, pc, 22 pin	X00803
XA3	Connector, pc, 22 pin	X00803
XA4	Connector, pc, 15 pin (2 used)	X00802
XDS1	Lampholder, white	X00501
XDS2	Lampholder, white	X00501
XDS3	Lampholder, white	X00501
XDS4	Lampholder, white	X00501
XDS5	Lampholder, white	X00501
XDS6	Lampholder, white	X00501
XDS7	Lampholder, white	X00501
XDS8	Lampholder, white	X00501
XDS9	Lampholder, white	X00501
XDS10	Lampholder, white	X00501
XDS11	Lampholder, green	X00503
XDS12	Lampholder, red	X00502
XF1	Fuseholder, clip-type	X00402
XF2	Fuseholder, clip-type	X00402
XF3	Fuseholder, clip-type	X00402
XF4	Fuseholder, clip-type	X00402
XF5	Fuseholder, clip-type	X00402
XK1	Not used	---
XK2	Not used	---
XK3	Socket, tube, 9 pin	X00203
XV1	Socket, tube, 3-500Z	110832
XV2	Socket, tube, 3-500Z	110832
A7	OUTPUT RELAY ASSEMBLY	110420
A7C1	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
A7C2	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
A7C3-C4	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
A7C5	Cap, mica, 15pF, 5%, 500 Vdcw	C05150
A7CR1	Diode, si, 1 Amp, 200V, 1N4003	CR4003
A7J1	Recept, 4 pin	J00200
A7J2	Recept, UHF, 4-hole mtg	J00301
A7J3	Recept, UHF, 4-hole mtg	J00301
A7J4	Recept, phono, bulkhead mtg	J00100
A7K1	Relay, ant, dpdt	150870



LEGEND:

A1 CONTROL BOARD
A2 MATRIX BOARD
A3 SERVO AMPL. BOARD
A4 TRIAC BOARD

Figure 6-1. LPA Component Locations, Front View

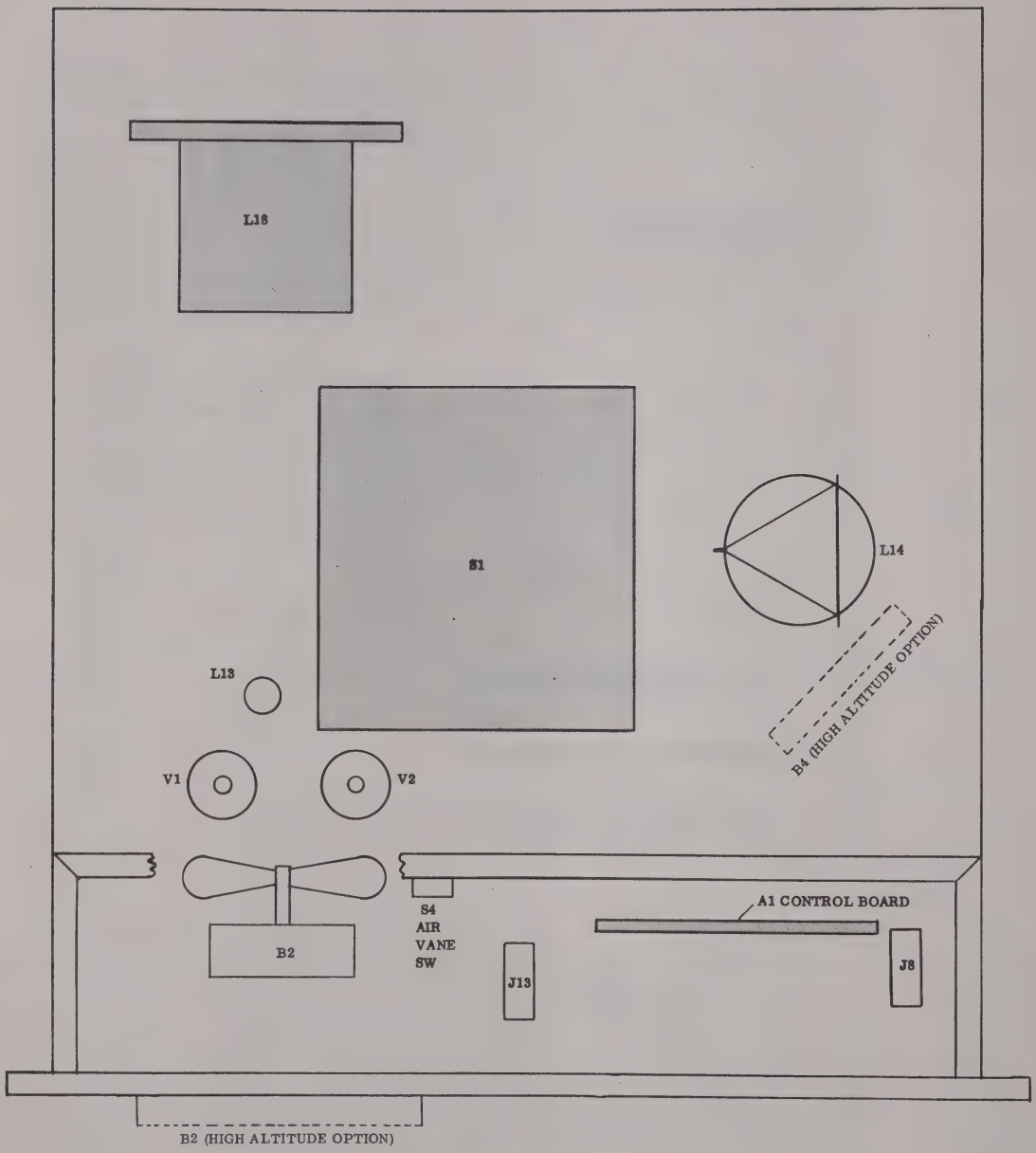


Figure 6-2. LPA Component Locations, Top View

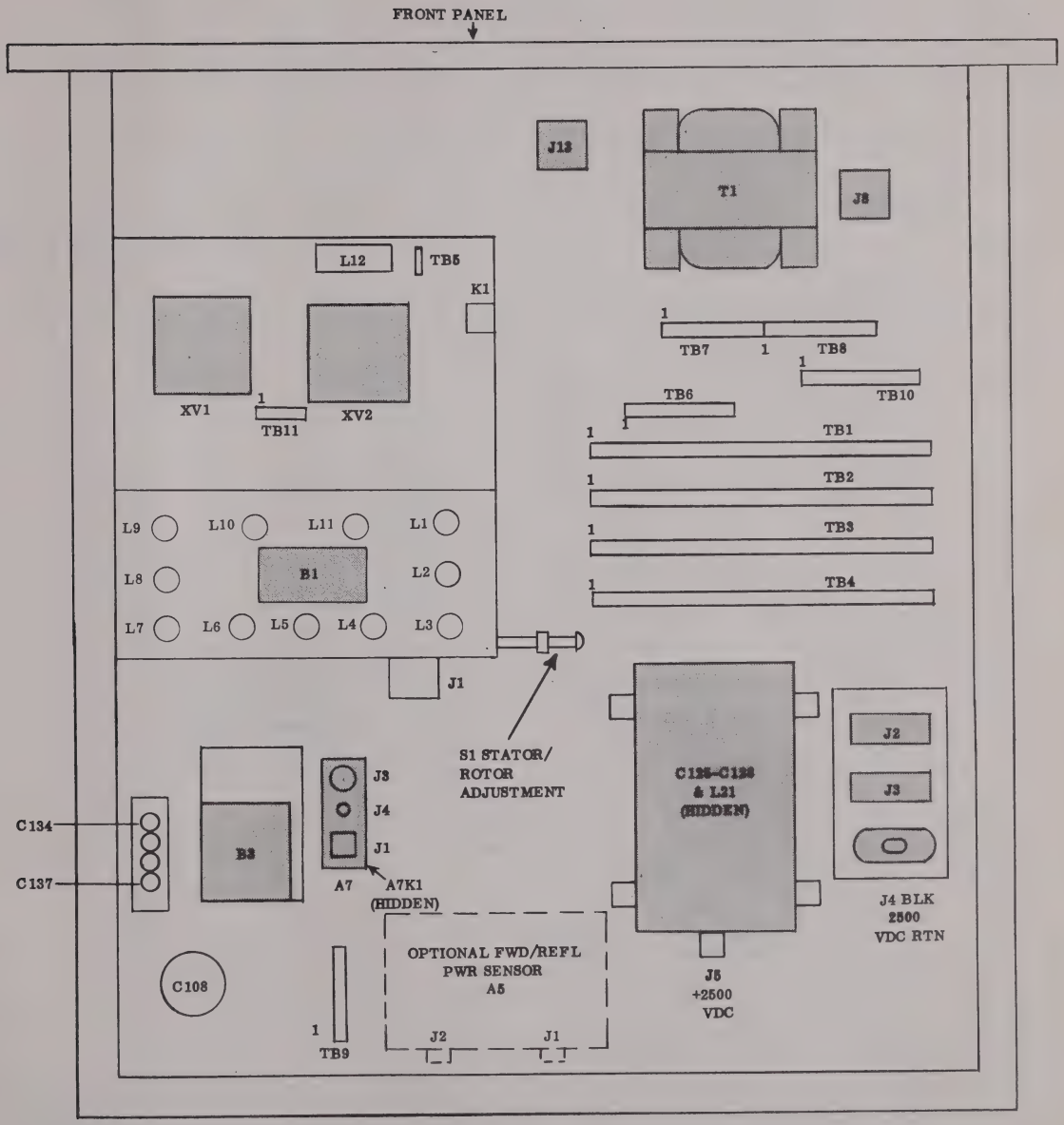


Figure 6-3. LPA Component Locations, Bottom View

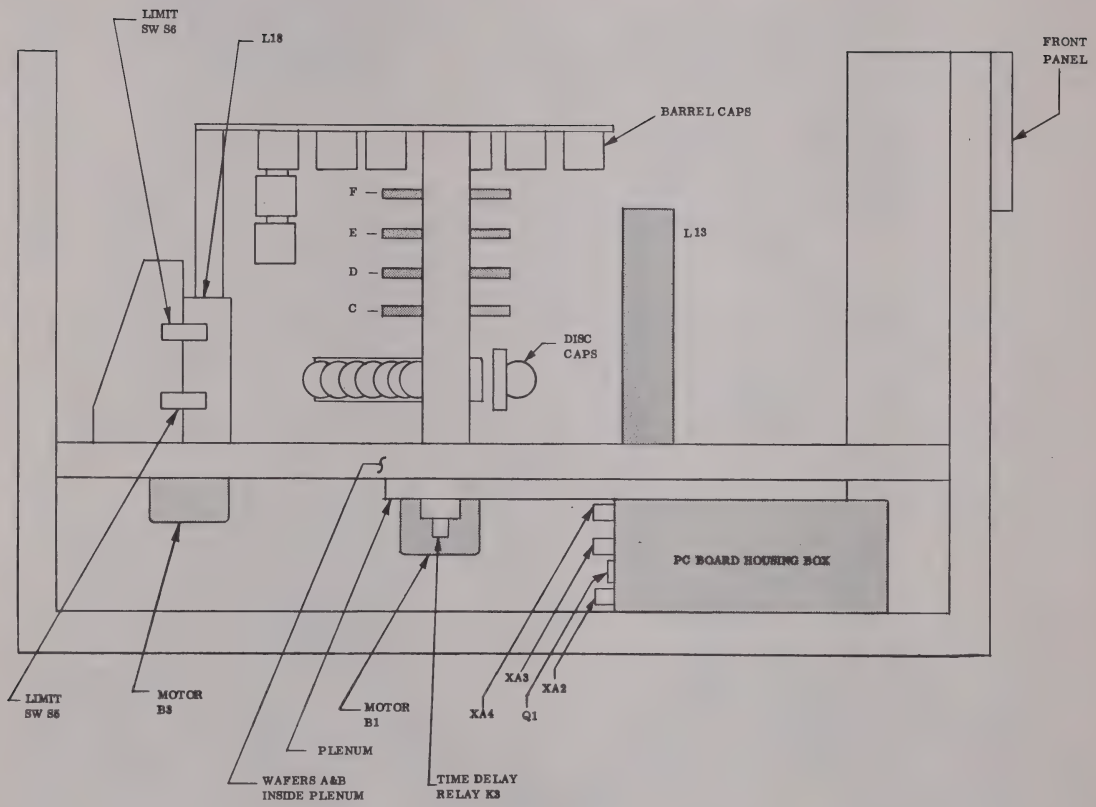


Figure 6-4. LPA Component Locations, Left Side View

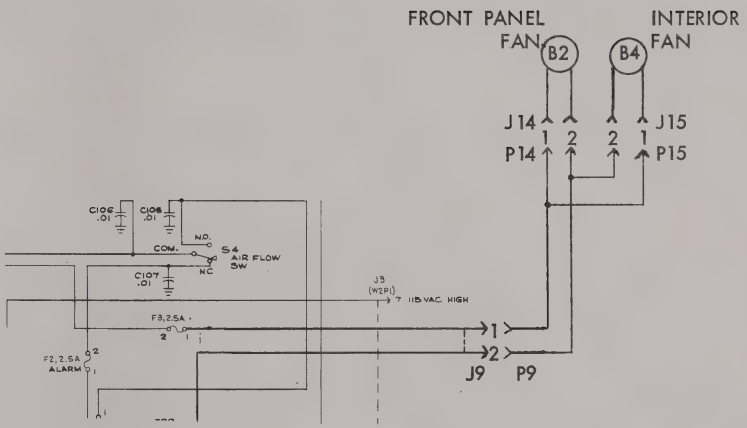
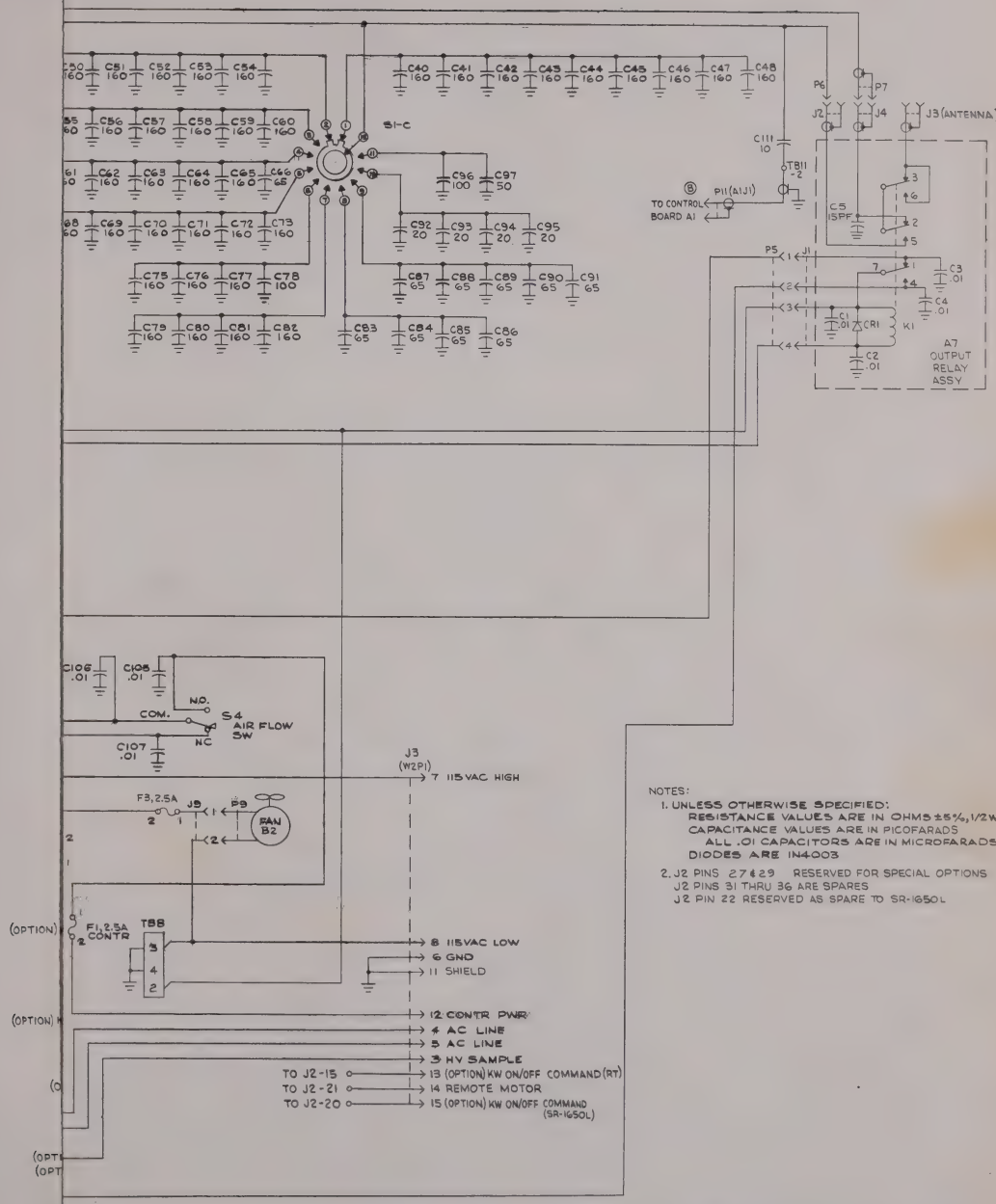


Figure 6-5. Changes in Fan Wiring for High-Altitude Option



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTANCE VALUES ARE IN OHMS ±5%, 1/2W
   CAPACITANCE VALUES ARE IN PICOFARADS
   ALL .01 CAPACITORS ARE IN MICROFARADS
   DIODES ARE 1N4003
2. J2 PINS 27 & 29 RESERVED FOR SPECIAL OPTIONS
   J2 PINS 31 THRU 36 ARE SPARES
   J2 PIN 22 RESERVED AS SPARE TO SR-1650L

Figure 6-6. SR-110 LPA, Main Frame, Schematic Diagram

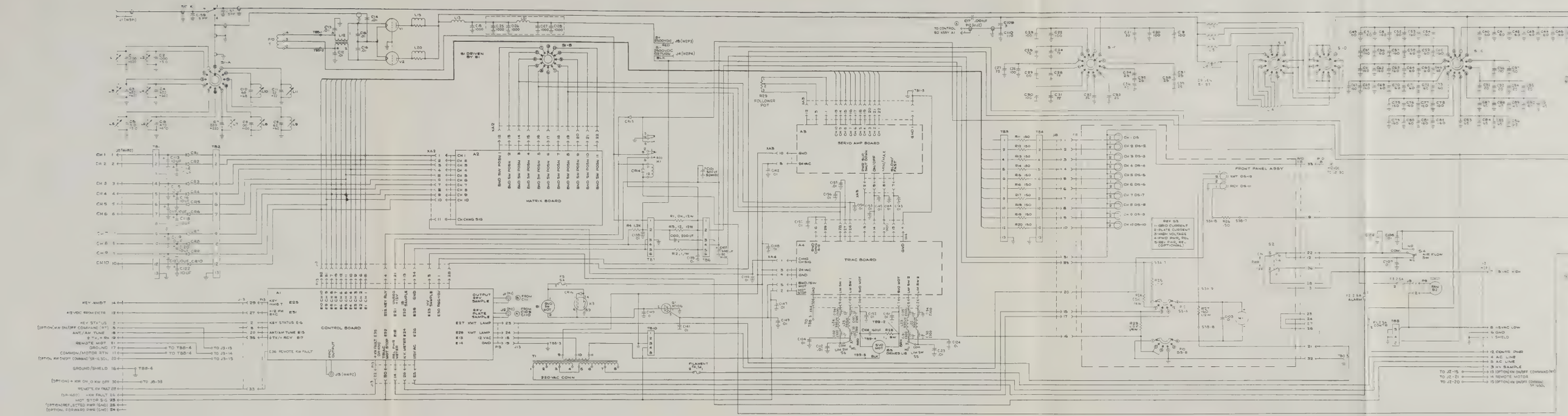


Figure 6-6. SR-110 LPA, Main Frame, Schematic Diagram

CHAPTER 7

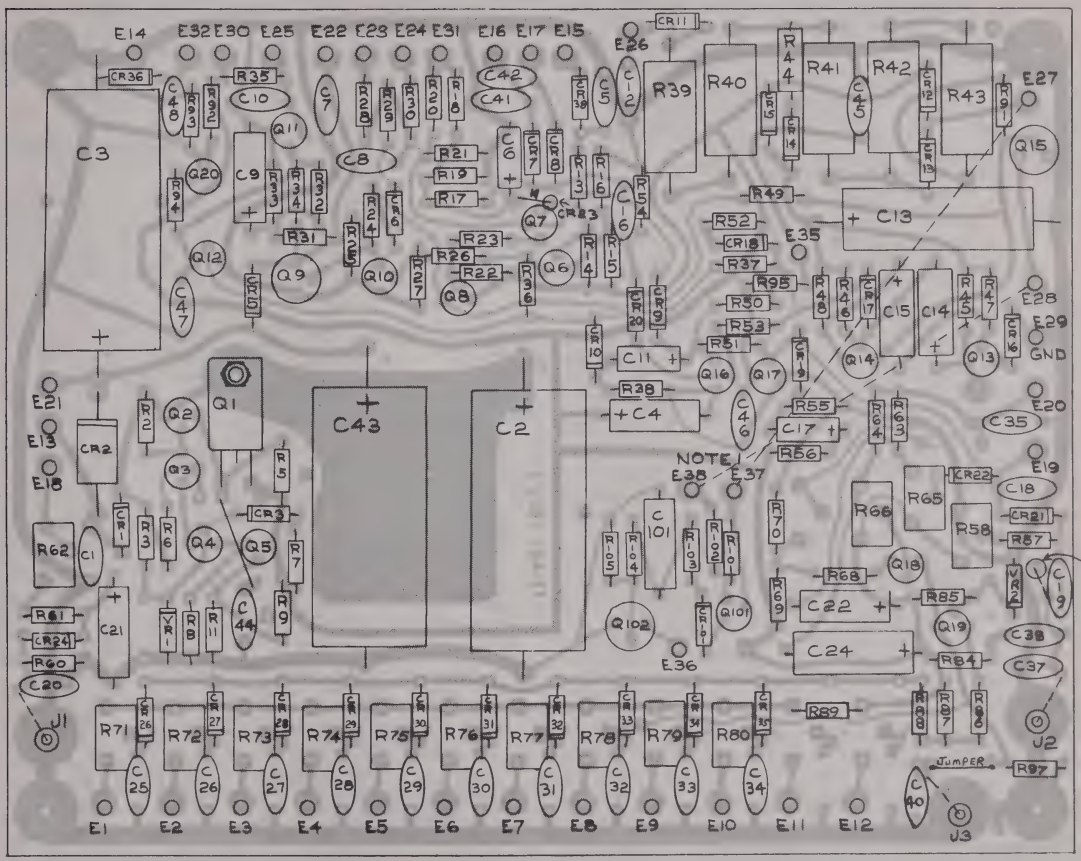
CONTROL BOARD ASSEMBLY 1A1A1

REF DESIG	DESCRIPTION	PART NO.
---	CONTROL BOARD ASSEMBLY	110486
C1	Cap, tant, 1.0μF, 10%, 35 Vdcw	C41056
C2	Cap, elect, 500μF, 50 Vdcw	C70003
C3	Cap, elect, 500μF, 50 Vdcw	C70003
C4	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C5	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C6	Cap, tant, 1.0μF, 10%, 35 Vdcw	C41056
C7	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C8	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C9	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C10	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C11	Cap, tant, 1.0μF, 10%, 35 Vdcw	C41056
C12	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C13	Cap, elect, 50μF, +100-10%, 50 Vdcw	C55067
C14	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C15	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C16	Cap, cer, 0.1μF, +80-20%, 25 Vdcw	C11000
C17	Cap, tant, 5.6μF, 10%, 35 Vdcw	C45656
C18	Cap, cer, 0.1μF, +80-20%, 25 Vdcw	C11000
C19	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C20	Cap, mica, 200pF, 5%, 500 Vdcw	C05201
C21	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C22	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C23	Not used	---
C24	Cap, tant, 100μF, 20%, 10 Vdcw	C41072
C25-C34	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C35	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C36	Not used	---
C37	Cap, mica, 220pF, 5%, 500 Vdcw	C05221
C38	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C39	Not used	---
C40	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C41	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C42	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C43	Cap, elect, 500μF, 50 Vdcw	C70003
C44	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C45	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C46	Cap, cer, 0.1μF, +80-20%, 25 Vdcw	C11000
C47	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C48	Cap, cer, 0.1μF, +80-20%, 25 Vdcw	C11000

REF DESIG	DESCRIPTION	PART NO.
CR1	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR2	Diode, si, 3 Amp, 100V, 3AF1	CR3AF1
CR3	Diode, si, signal, 1N4148	CR4148
CR4	Not used	---
CR5	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR6	Diode, si, signal, 1N4148	CR4148
CR7	Diode, si, signal, 1N4148	CR4148
CR8	Diode, si, signal, 1N4148	CR4148
CR9	Diode, si, signal, 1N4148	CR4148
CR10	Diode, si, signal, 1N4148	CR4148
CR11	Diode, si, 1 Amp, 1 kV, 1N4007	CR4007
CR12	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR13	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR14	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR15	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR16-CR36	Diode, si, signal, 1N4148	CR4148
CR37	Not used	---
CR38	Diode, si, signal, 1N4148	CR4148
J1-J3	Recept, phono, staked mtg	J00101
P1	Connector, 36 pin male	P00253
Q1	Transistor, npn, power, 2N5296	Q52960
Q2	Transistor, pnp, 2N4125	Q41250
Q3	Transistor, npn, 2N4123	Q41230
Q4	Transistor, npn, 2N4123	Q41230
Q5	Transistor, npn, 2N4123	Q41230
Q6	Transistor, pnp, 2N4125	Q41250
Q7	Transistor, npn, 2N4123	Q41230
Q8	Transistor, pnp, 2N4125	Q41250
Q9	Transistor, npn, 2N4400	Q44000
Q10	Transistor, npn, 2N4123	Q41230
Q11	Transistor, npn, 2N4123	Q41230
Q12	Transistor, npn, 2N4123	Q41230
Q13	Transistor, npn, 2N4123	Q41230
Q14	Transistor, npn, 2N4123	Q41230
Q15	Transistor, npn, 2N1613	Q16130
Q16	Transistor, npn, 2N4123	Q41230
Q17	Transistor, npn, 2N4123	Q41230
Q18	Transistor, pnp, 2N4125	Q41250
Q19	Transistor, pnp, 2N4125	Q41250
Q20	Transistor, pnp, 2N4125	Q41250
R1	Not used	---
R2	Res, comp, 680Ω, 5%, 1/4W	R20681
R3	Res, comp, 22K, 5%, 1/4W	R20223
R4	Not used	---
R5	Res, comp, 4.7K, 5%, 1/4W	R20472
R6	Res, comp, 22K, 5%, 1/4W	R20223
R7	Res, comp, 2.2K, 5%, 1/4W	R20222
R8	Res, comp, 1.2K, 5%, 1/4W	R20122
R9	Res, film, 1.5K, 1%, 1/4W	110924
R10	Not used	---
R11	Res, film, 1.5K, 1%, 1/4W	110924
R12	Not used	---
R13	Res, comp, 10K, 5%, 1/4W	R20103

REF DESIG	DESCRIPTION	PART NO.
R14	Res, comp, 10K, 5%, 1/4W	R20103
R15	Res, comp, 2.2K, 5%, 1/4W	R20222
R16	Res, comp, 10K, 5%, 1/4W	R20103
R17	Res, comp, 1K, 5%, 1/4W	R20102
R18	Res, comp, 4.7K, 5%, 1/4W	R20472
R19	Res, comp, 12K, 5%, 1/4W	R20123
R20	Res, comp, 10K, 5%, 1/4W	R20103
R21	Res, comp, 10K, 5%, 1/4W	R20103
R22	Res, comp, 10K, 5%, 1/4W	R20103
R23	Res, comp, 33K, 5%, 1/4W	R20333
R24	Res, comp, 2.7K, 5%, 1/4W	R20272
R25	Res, comp, 3.3K, 5%, 1/4W	R20332
R26	Res, comp, 3.3K, 5%, 1/4W	R20332
R27	Res, comp, 1K, 5%, 1/4W	R20102
R28	Res, comp, 82K, 5%, 1/4W	R20823
R29	Res, comp, 220K, 5%, 1/4W	R20224
R30	Res, comp, 33K, 5%, 1/4W	R20333
R31	Res, comp, 10K, 5%, 1/4W	R20103
R32	Res, comp, 10K, 5%, 1/4W	R20103
R33	Res, comp, 10K, 5%, 1/4W	R20103
R34	Res, comp, 33K, 5%, 1/4W	R20333
F35	Res, comp, 18K, 5%, 1/4W	R20183
R36	Res, comp, 33K, 5%, 1/4W	R20333
R37	Res, comp, 33K, 5%, 1/4W	R20333
R38	Res, comp, 33K, 5%, 1/4W	R20333
R39	Res, comp, 180Ω, 5%, 2W	R50181
R40-R43	Res, comp, 180Ω, 5%, 2W	R50181
R44	Res, comp, 2.7K, 5%, 1/2W	R30272
R45	Res, comp, 2.7K, 5%, 1/4W	R20272
R46	Res, comp, 47K, 5%, 1/4W	R20473
R47	Res, comp, 47K, 5%, 1/4W	R20473
R48	Res, comp, 2.7K, 5%, 1/4W	R20272
R49	Res, comp, 2.7K, 5%, 1/4W	R20272
R50	Res, comp, 2.7K, 5%, 1/4W	R20272
R51	Res, comp, 18K, 5%, 1/4W	R20183
R52	Res, comp, 2.7K, 5%, 1/4W	R20272
R53	Res, comp, 18K, 5%, 1/4W	R20183
R54	Res, comp, 47K, 5%, 1/4W	R20473
R55	Res, comp, 10K, 5%, 1/4W	R20103
R56	Res, comp, 4.7K, 5%, 1/4W	R20472
R57	Res, comp, 3.3K, 5%, 1/4W	R20332
R58	Pot, trim, pc, 10K	110965
R59	Not used	---
R60	Res, comp, 3.3K, 5%, 1/4W	R20332
R61	Res, comp, 82K, 5%, 1/4W	R20823
R62	Pot, trim, pc, 50K	110966
R63	Res, comp, 2.2K, 5%, 1/4W	R20222
R64	Res, comp, 47K, 5%, 1/4W	R20473
R65	Pot, trim, pc, 50K	110966
R66	Pot, trim, pc, 50K	110966
R67	Not used	---
R68	Res, comp, 100Ω, 5%, 1/4W	R20101
R69	Res, comp, 3.3K, 5%, 1/4W	R20332
R70	Res, comp, 12K, 5%, 1/4W	R20123
R71-R80	Pot, trim, pc, 10K	110965
R81	Not used	---

REF DESIG	DESCRIPTION	PART NO.
R82	Not used	---
R83	Not used	---
R84	Res, comp, 3.3K, 5%, 1/4W	R20332
R85	Res, comp, 1K, 5%, 1/4W	R20102
R86	Res, comp, 470Ω, 5%, 1/4W	R20471
R87	Res, comp, 1.5K, 5%, 1/4W	R20152
R88	Res, comp, 1.2K, 5%, 1/4W	R20122
R89	Res, comp, 10K, 5%, 1/4W	R20103
R90	Not used	---
R91	Res, comp, 6.8K, 5%, 1/4W	R20682
R92	Res, comp, 12K, 5%, 1/4W	R20123
R93	Res, comp, 18K, 5%, 1/4W	R20183
R94	Res, comp, 22K, 5%, 1/4W	R20223
R95	Res, comp, 10K, 5%, 1/4W	R20103
R96	Res, comp, 3.3K, 5%, 1/4W	R20332
R97	Res, comp, 1.2K, 5%, 1/4W	R20122
VR1	Diode, zener, 5.6V, 5%, 400mW, 1N752A	VR7520



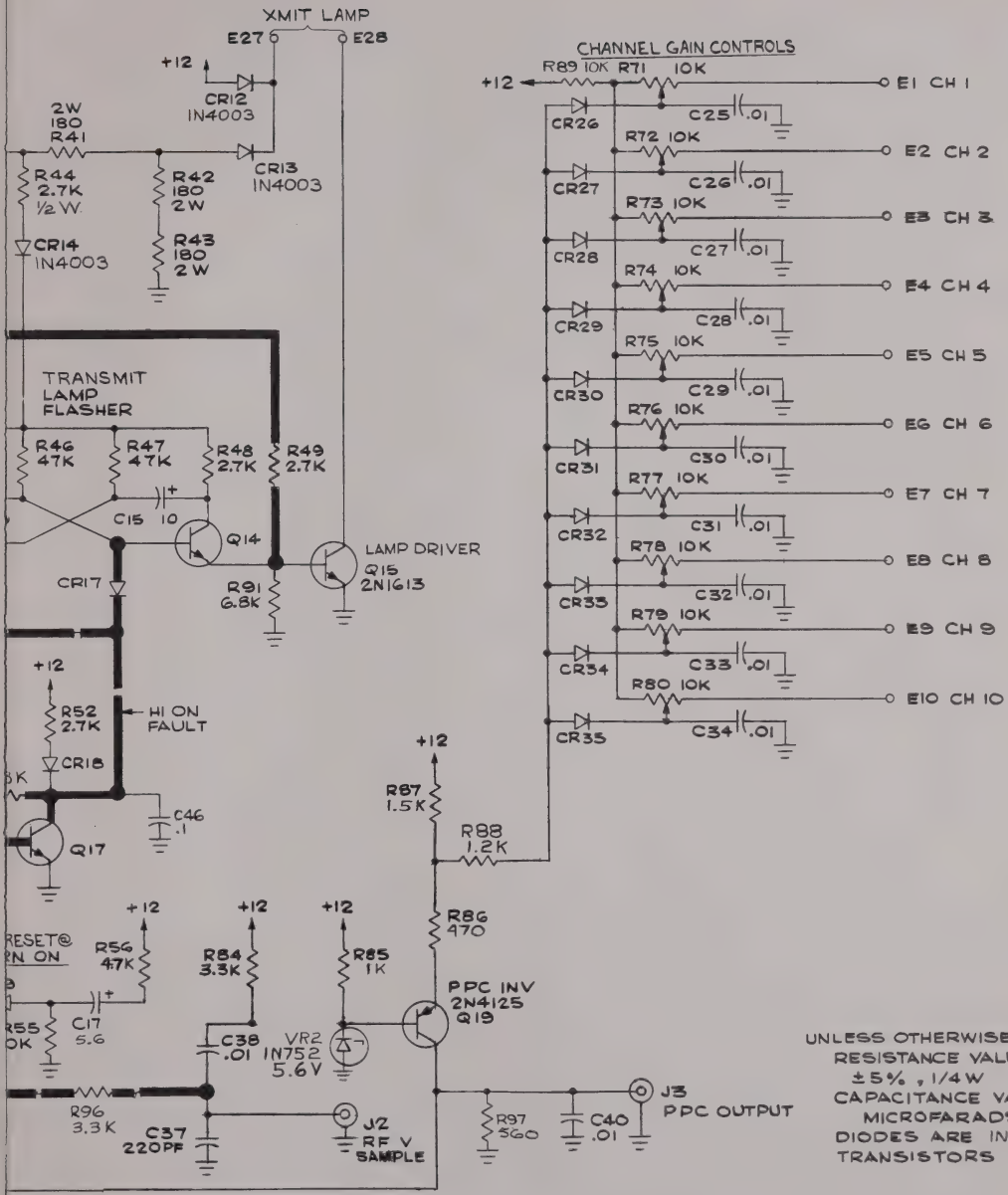
NOTE

1. INSTALL JUMPERS E27-E37, E28-E38 FAR SIDE OF BOARD.

NOTE

Illustration includes Remote Fault Option components described in Chapter 16.

Figure 7-1. Control Board Assembly 1A1A1, Component Locations



UNLESS OTHERWISE SPECIFIED:
RESISTANCE VALUES ARE IN OHMS
±5%, 1/4W
CAPACITANCE VALUES ARE IN MICROFARADS
DIODES ARE IN4148
TRANSISTORS ARE 2N4123

Figure 7-2. Control Board Assembly 1A1A1, Schematic Diagram

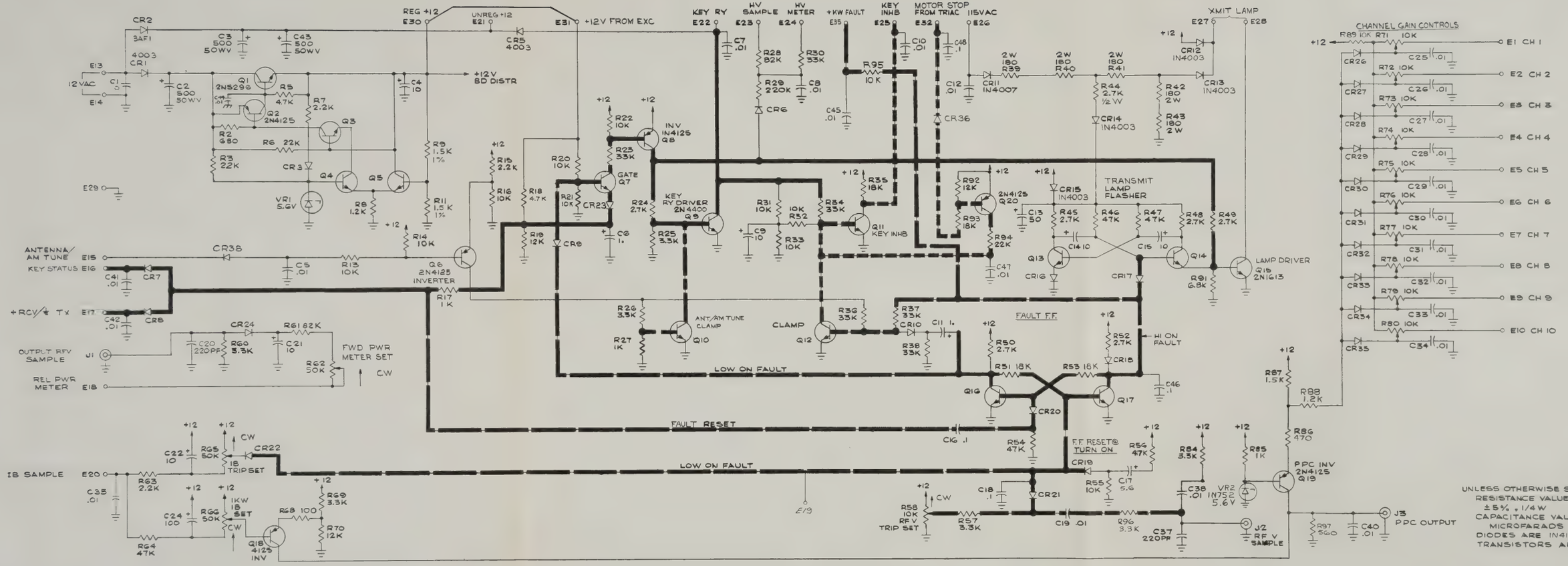


Figure 7-2. Control Board Assembly 1A1A1, Schematic Diagram

CHAPTER 8

MATRIX BOARD ASSEMBLY 1A1A2

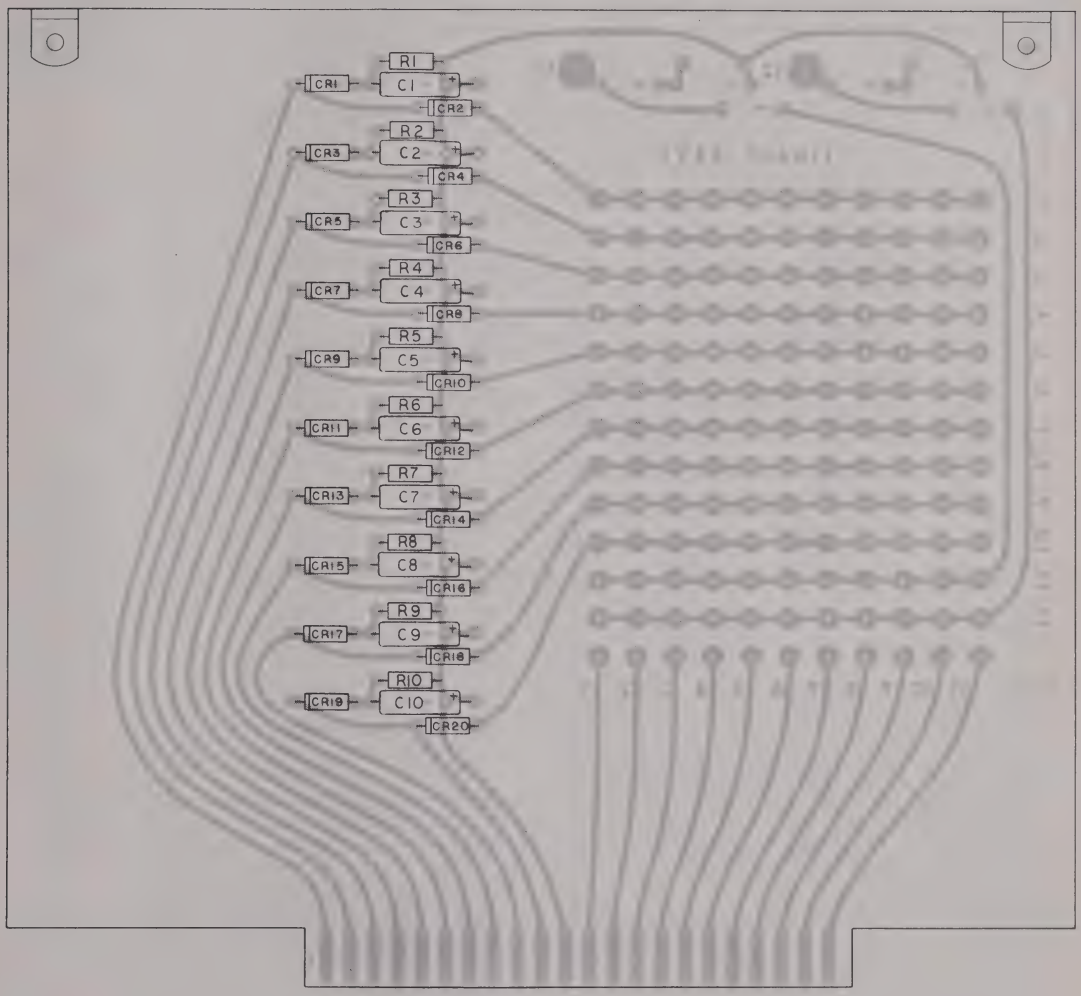


Figure 8-1. Matrix Board Assembly 1A1A2, Component Locations

REF DESIG	DESCRIPTION	PART NO.
---	MATRIX BOARD ASSEMBLY	110430
C1-C10	Cap, tant, 5.6μF, 10%, 35 Vdcw	C45656
CR1-CR20	Diode, si, signal, 1N4148	CR4148
R1-R10	Res, comp, 100K, 5%, 1/4W	R20104

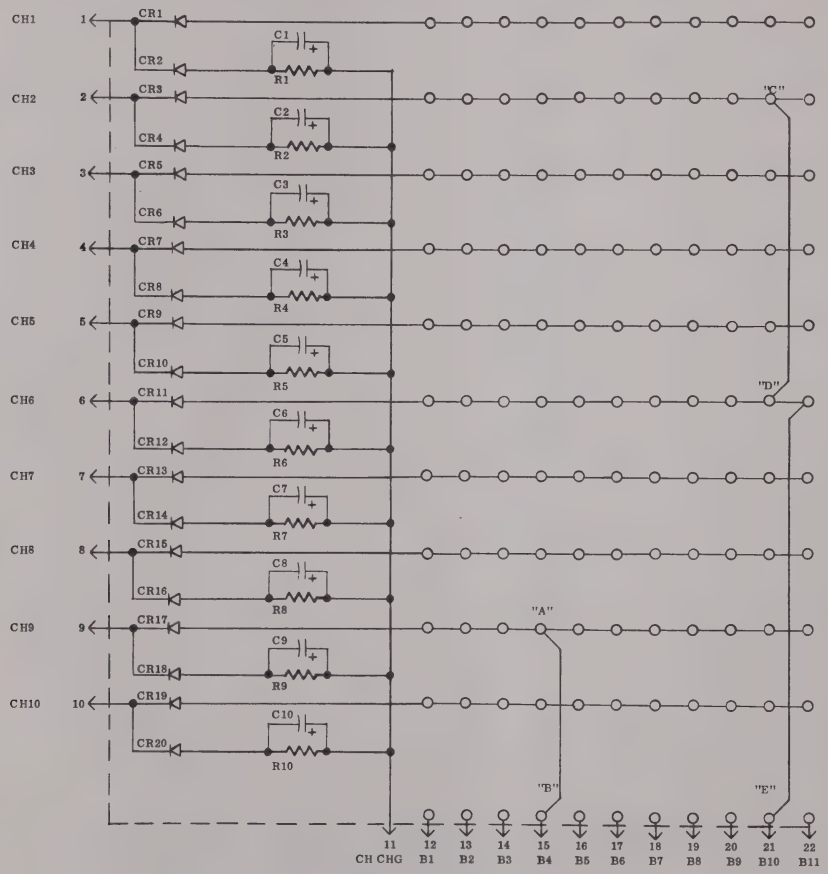


Figure 8-2. Matrix Board Assembly 1A1A2, Schematic Diagram with Sample Jumpers Shown

CHAPTER 9

SERVO BOARD ASSEMBLY 1A1A3

REF DESIG	DESCRIPTION	PART NO.
---	SERVO BOARD ASSEMBLY	110490
C1	Not used	---
C2	Cap, elect, 500μF, 50 Vdcw	C70003
C3-C5	Cap, tant, 1.0μF, 10%, 35 Vdcw	C41056
C6	Not used	---
C7	Cap, tant, 22μF, 10%, 15 Vdcw	C42263
C8-C31	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C32	Not used	---
C33	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
C34-C39	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C40	Not used	---
C41-C42	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
CR1	Diode, si, signal, 1N4148	CR4148
CR2	Diode, si, signal, 1N4148	CR4148
CR3-CR4	Not used	---
CR5	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR6	Diode, si, signal, 1N4148	CR4148
CR7-CR9	Not used	---
CR10-CR19	Diode, si, signal, 1N4148	CR4148
L1	Choke, rf, 1000μH	L10102
L2	Choke, rf, 1000μH	L10102
Q1	Transistor, pnp, 2N4125	Q41250
Q2	Transistor, pnp, 2N4125	Q41250
Q3	Transistor, pnp, 2N4125	Q41250
Q4	Transistor, pnp, 2N4125	Q41250
Q5	Transistor, npn, power, D44C8	Q00004
Q6	Transistor, npn, power, D44C8	Q00004
Q7	Transistor, npn, power, D44C8	Q00004
Q8	Transistor, npn, power, 2N5296	Q52960
Q9	Transistor, pnp, 50V, 2N5086	Q50860
Q10	Transistor, npn, 2N1613	Q16130
Q11	Transistor, npn, 2N4400	Q44000
Q12-Q21	Transistor, pnp, 2N4125	Q41250
R1	Res, comp, 2.2K, 5%, 1/4W	R20222
R2	Pot, trim, pc, 1K	R88102
R3	Res, comp, 470Ω, 5%, 1/4W	R20471
R4	Res, comp, 1.8K, 5%, 1/4W	R20182
R5	Res, comp, 1.8K, 5%, 1/4W	R20182

REF DESIG	DESCRIPTION	PART NO.
R6	Res, comp, 5.6K, 5%, 1/4W	R20562
R7	Res, comp, 5.6K, 5%, 1/4W	R20562
R8	Res, comp, 5.6K, 5%, 1/4W	R20562
R9	Res, comp, 5.6K, 5%, 1/4W	R20562
R10	Res, comp, 3.3K, 5%, 1/4W	R20332
R11	Res, comp, 10K, 5%, 1/4W	R20103
R12	Res, comp, 8.2K, 5%, 1/4W	R20822
R13	Res, comp, 4.7K, 5%, 1/4W	R20472
R14	Not used	---
R15	Res, comp, 8.2K, 5%, 1/4W	R20822
R16	Res, comp, 4.7K, 5%, 1/4W	R20472
R17	Not used	---
R18	Res, comp, 470Ω, 5%, 1/2W	R30471
R19	Res, comp, 4.7K, 5%, 1/4W	R20472
R20	Not used	---
R21-R30	Pot, trim, pc, 1K, 10-turn	R90007
R31	Res, comp, 330Ω, 5%, 2W	R50331
R32	Res, comp, 100Ω, 5%, 1/2W	R30101
R33	Res, comp, 680Ω, 5%, 1/4W	R20681
R34	Res, comp, 22K, 5%, 1/4W	R20223
R35	Not used	---
R36	Res, comp, 2.2K, 5%, 1/4W	R20222
R37	Res, comp, 1.2K, 5%, 1/4W	R20122
R38	Res, film, 4.12K, 1%, 1/4W	110925
R39	Not used	---
R40	Res, film, 1.50K, 1%, 1/4W	110924
R41-R50	Res, comp, 100K, 5%, 1/4W	R20104
R51-R60	Res, comp, 10K, 5%, 1/4W	R20103
R61	Res, comp, 4.7K, 5%, 1/4W	R20472
U1	IC, rf ampl, CA-3028A	U3028A
VR1	Diode, zener, 10V, 5%, 400mW, 1N758A	VR7580
VR2	Diode, zener, 5.6V, 5%, 400mW, 1N752A	VR7520

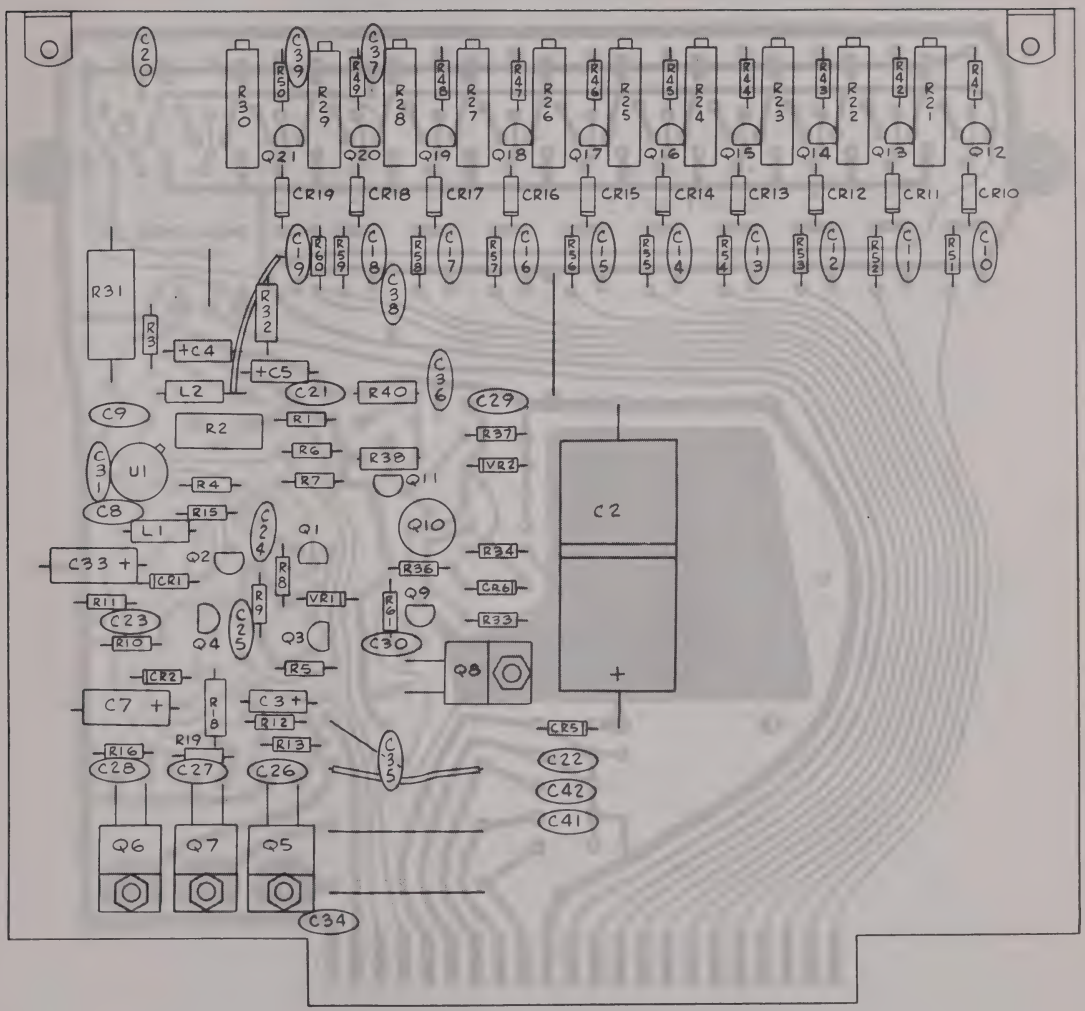
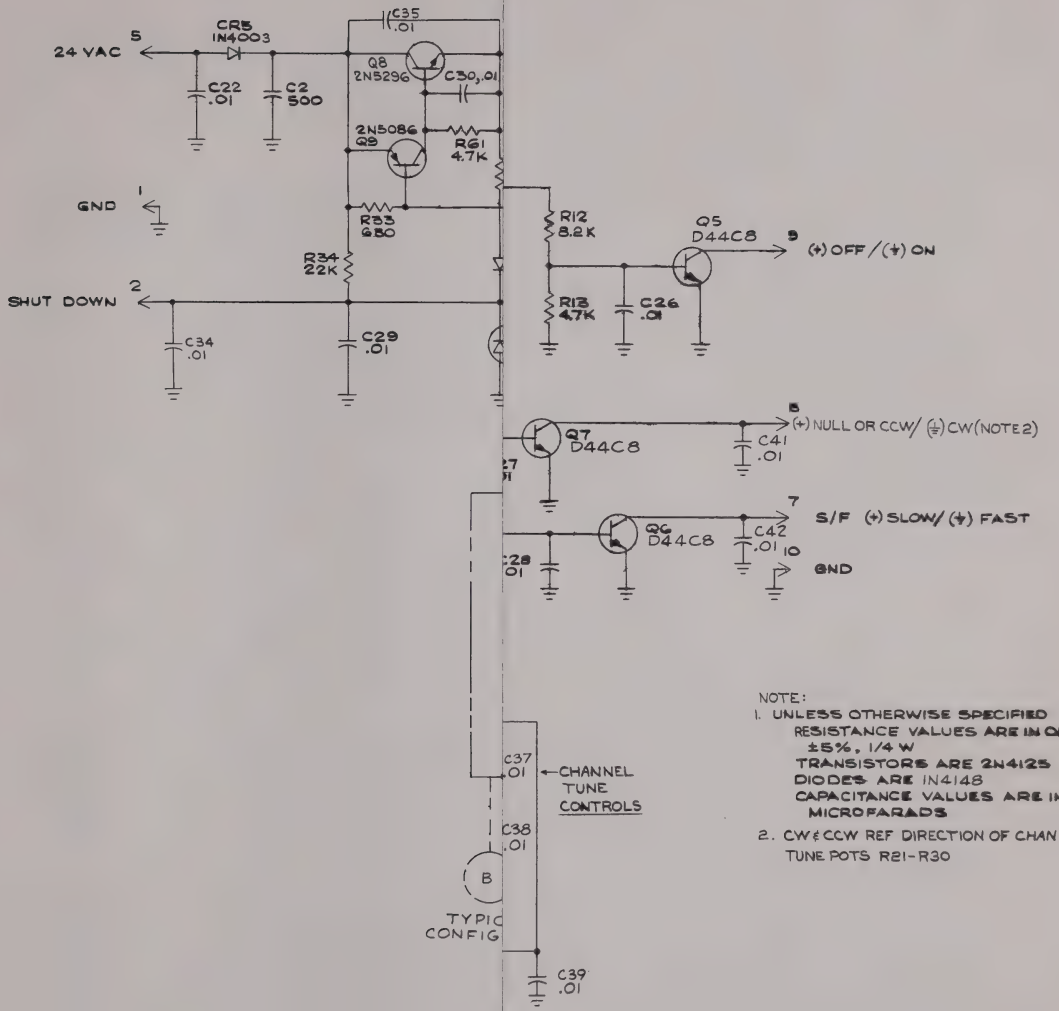
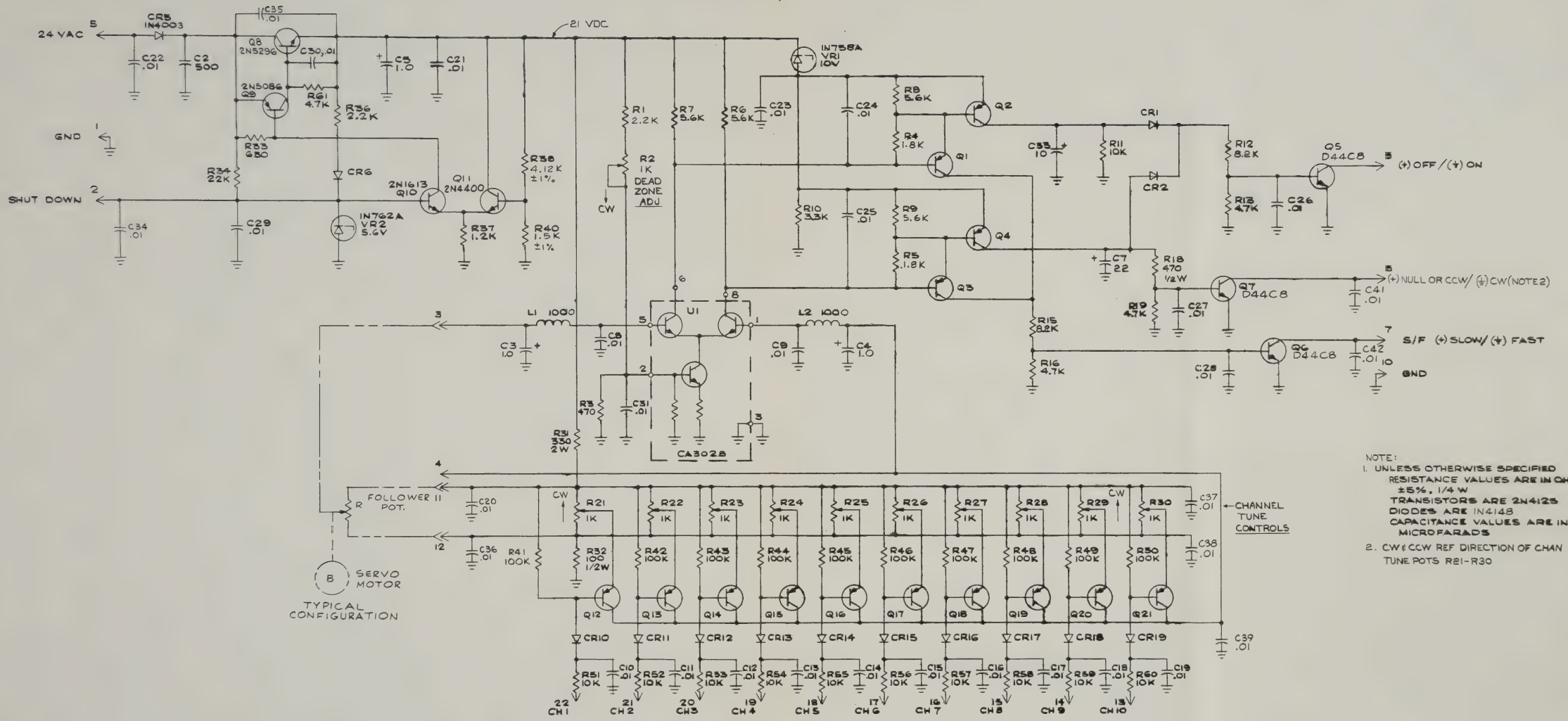


Figure 9-1. Servo Board Assembly 1A1A3, Component Locations



NOTE:
1. UNLESS OTHERWISE SPECIFIED
   RESISTANCE VALUES ARE IN OHMS
   ±5%, 1/4 W
   TRANSISTORS ARE 2N4125
   DIODES ARE IN4148
   CAPACITANCE VALUES ARE IN
   MICROFARADS
2. CW & CCW REF DIRECTION OF CHAN
   TUNE POTS R21-R30

Figure 9-2. Servo Board Assembly 1A1A3, Schematic Diagram



NOTE:
1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS ±5%, 1/4 W TRANSISTORS ARE 2N4125 DIODES ARE IN4148 CAPACITANCE VALUES ARE IN MICROFARADS
2. CW & CCW REF DIRECTION OF CHAN TUNE POTS R21-R30

Figure 9-2. Servo Board Assembly 1A1A3, Schematic Diagram

CHAPTER 10

TRIAC BOARD ASSEMBLY 1A1A4

REF DESIG	DESCRIPTION	PART NO.
---	TRIAC BOARD ASSEMBLY	110438
C1	Cap, elect, 500μF, 50 Vdcw	C70003
C2	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C3	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C4	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C5	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C6	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C7-C12	Not used	---
C13	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C14	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C15	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C16	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C17	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C18	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C19	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C20	Cap, cer, 0.1μF, +80-20%, 25 Vdcw	C11000
C21	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
CR1	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR2	Diode, si, 1 Amp, 200V, 1N4003	CR4003
CR3	Diode, si, signal, 1N4148	CR4148
CR4	Diode, si, signal, 1N4148	CR4148
CR5	Diode, si, signal, 1N4148	CR4148
CR6	Diode, si, signal, 1N4148	CR4148
Q1	Transistor, npn, 2N1613	Q16130
Q2	Transistor, pnp, 50V, 2N5086	Q50860
Q3	Transistor, npn, power, D44C8	Q00004
Q4	Transistor, npn, 2N1613	Q16130
Q5	Transistor, pnp, 50V, 2N5086	Q50860
Q6	Transistor, npn, power, D44C8	Q00004
Q7	Not used	---
Q8	Transistor, npn, power, 2N5296	Q52960
Q9	Triac, A01061	Q00003
Q10	Triac, A01061	Q00003
Q11	Not used	---
Q12	Transistor, npn, 2N4123	Q41230
Q13	Transistor, npn, 2N4123	Q41230
R1	Res, comp, 5.6K, 5%, 1/4W	R20562
R2	Res, comp, 10K, 5%, 1/4W	R20103
R3	Res, comp, 8.2K, 5%, 1/4W	R20822
R4	Res, comp, 4.7K, 5%, 1/4W	R20472
R5	Res, comp, 10K, 5%, 1/4W	R20103

REF DESIG	DESCRIPTION	PART NO.
R6	Res, comp, 3.3K, 5%, 1/4W	R20332
R7	Res, ww, 180Ω, 5W	110922
R8	Res, ww, 220Ω, 5W	110923
R9	Res, comp, 470Ω, 5%, 1W	R40471
R10	Res, comp, 33K, 5%, 1/4W	R20333
R11	Not used	---
R12	Res, comp, 8.2K, 5%, 1/4W	R20822
R13	Res, comp, 4.7K, 5%, 1/4W	R20472
R14	Res, comp, 1K, 5%, 1/4W	R20102
R15	Res, comp, 3.3K, 5%, 1/4W	R20332
R16	Res, ww, 220Ω, 5W	110923
R17	Res, comp, 39Ω, 5%, 1/2W	R30390
R18	Not used	---
R19	Res, comp, 47Ω, 5%, 1/2W	R30470
R20	Res, comp, 1K, 5%, 1/4W	R20102
R21	Not used	---
R22	Res, comp, 6.8K, 5%, 1/4W	R20682
R23	Not used	---
R24	Res, comp, 68K, 5%, 1/4W	R20683
R25	Res, comp, 10K, 5%, 1/4W	R20103
R26	Res, comp, 33K, 5%, 1/4W	R20333
R27	Res, comp, 10K, 5%, 1/4W	R20103
R28-R37	Not used	---
R38	Res, comp, 470Ω, 5%, 2W	R50471
R39-R41	Res, comp, 1.8K, 5%, 1/4W	R20182
R42-R44	Res, comp, 10K, 5%, 1/4W	R20103
S1	Switch, slide, dpdt	S00202
VR1	Diode, zener, 10V, 5%, 400mW, 1N758A	VR7580
VR2	Diode, zener, 6.8V, 5%, 400mW, 1N754A	VR7540
VR3	Diode, zener, 12V, 5%, 1W, 1N4742A	VR4742

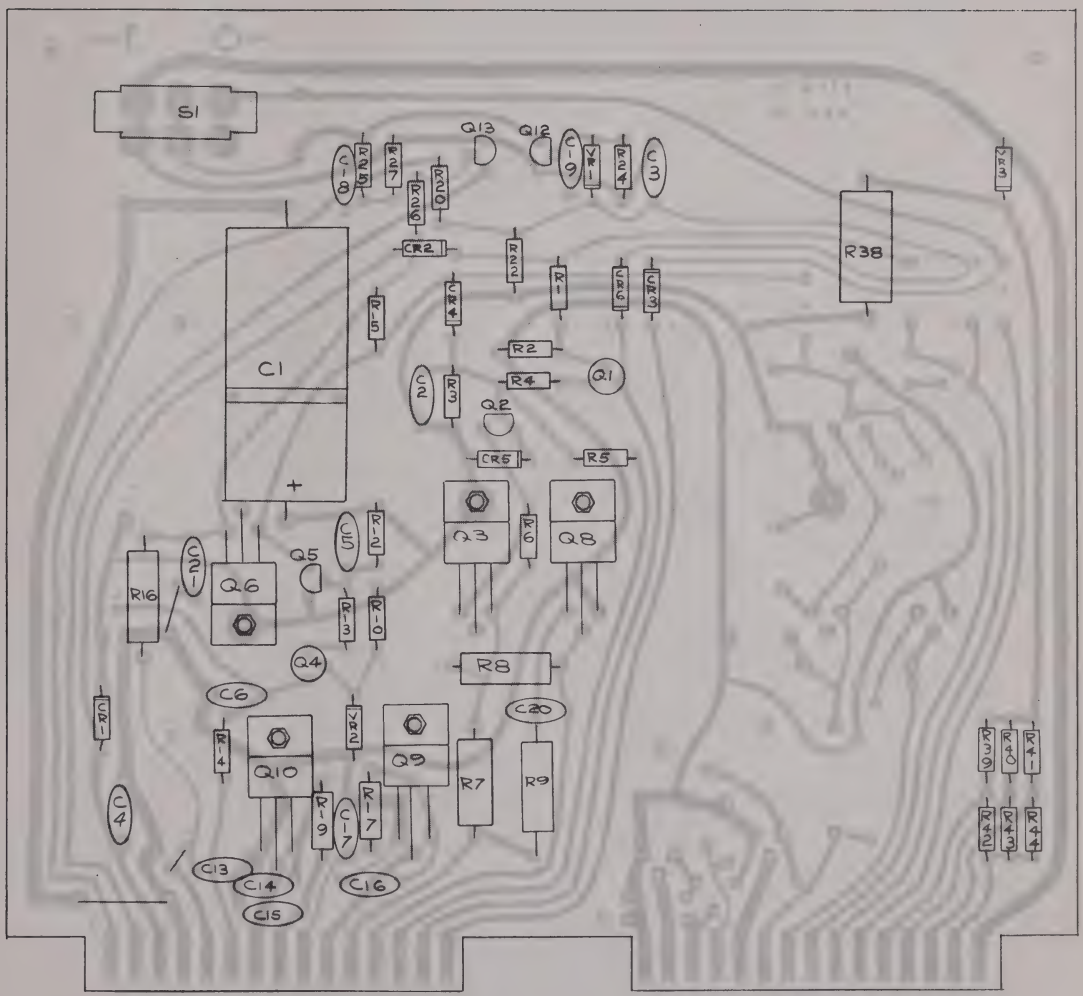


Figure 10-1. Triac Board Assembly 1A1A4, Component Locations

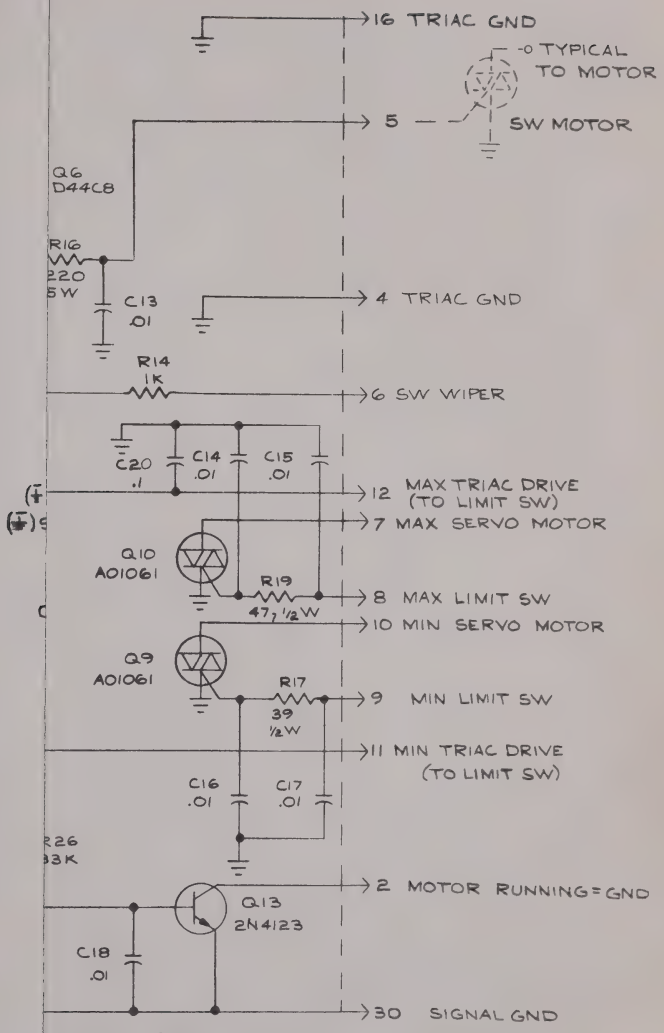
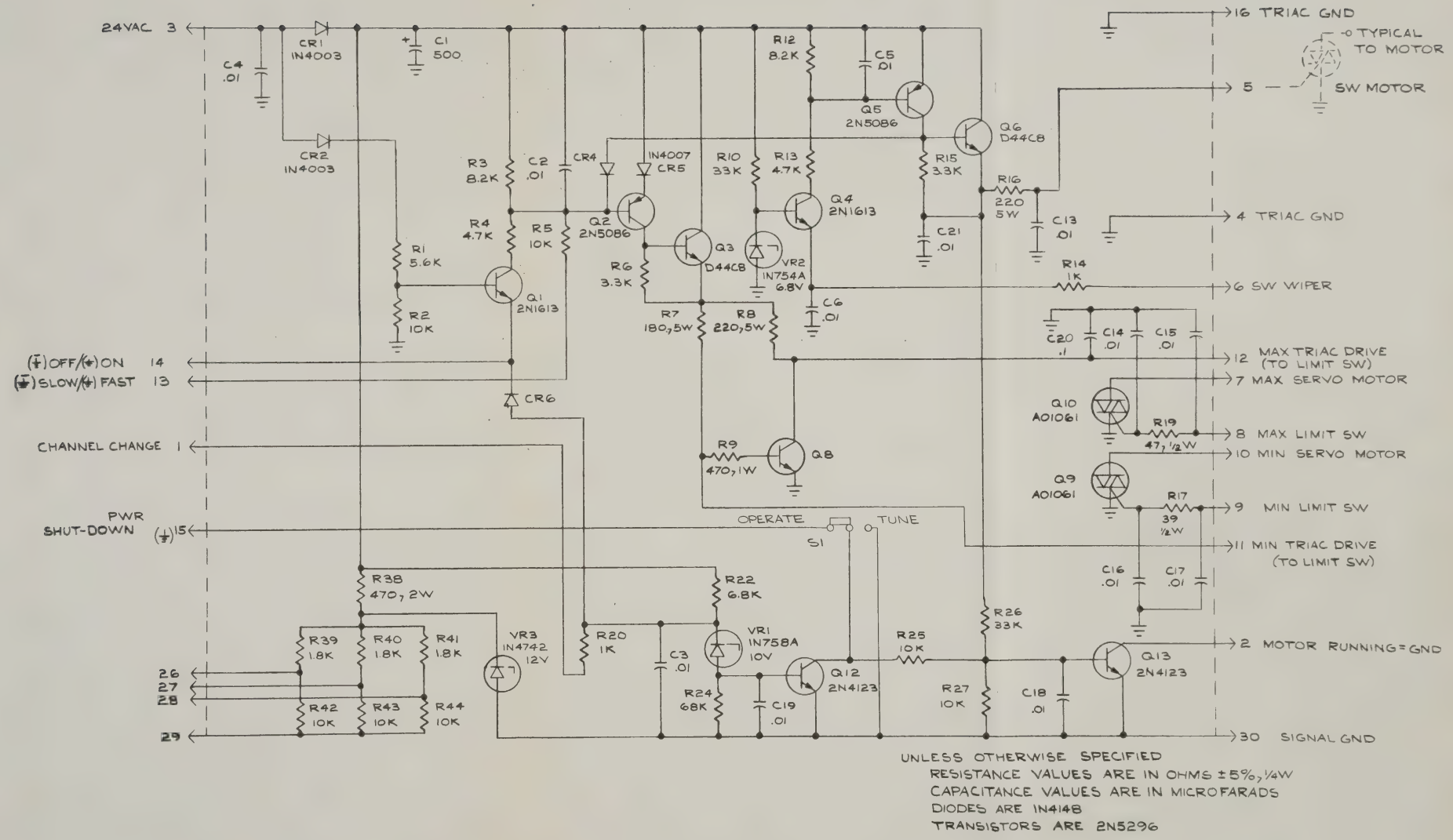


Figure 10-2. Triac Board Assembly 1A1A4, Schematic Diagram



UNLESS OTHERWISE SPECIFIED
RESISTANCE VALUES ARE IN OHMS ±5%, ¼W
CAPACITANCE VALUES ARE IN MICROFARADS
DIODES ARE IN4148
TRANSISTORS ARE 2N5296

Figure 10-2. Triac Board Assembly 1A1A4, Schematic Diagram

CHAPTER 11

POWER SUPPLY UNIT 1A2

REF DESIG	DESCRIPTION	PART NO.
---	AR-150A POWER SUPPLY UNIT	110750
C1	Cap, filter, 10μF, 4 kVdcw	110809
C2	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
C3	Cap, cer, barrel, 1000pF, 5 kVdcw, hi-k	C00064
CB1	Circuit breaker, 25 Amp, fast-blo	110810
CB2	Circuit breaker, 25 Amp, fast-blo	110810
CR1	Rectifier, bridge, high voltage	110848
FL1	Filter assembly	110770
FL1C1-C4	Cap, cer, .01μF, 1.6 kVdcw	C00001
FL1F1	For 115 Vac: Fuse, 3AG, slo-blo, 2 Amp, 125V	F20200
	For 230 Vac: Fuse, 3AG, slo-blo, 1 Amp, 125V	F20100
FL1L1-L2	Coil Assembly	110853
FL1XF1	Fuseholder, clip-type	X00402
J1	Conn, recept, hv, red	110893
J2	Conn, recept, hv, black	110894
J3	Connector, 36 pin female	J00253
J4	Connector, 36 pin female	J00253
K1	Contactor, two ckt, 115 Vac coil	110811
L1	Choke, filter, swinging	110812
R1	Res, ww, 100K, 225W	110819
R2	Res, ww, 1K, 5W	110820
R3	Res, ww, 1K, 5W	110820
R4	Res, ww, 50Ω, 12W	110821
T1	Transformer, high voltage	110813
T2	Transformer, isolation, 115/230 Vac to 115 Vac, 150 VA	T00114
	with high-altitude option	110980
TB1	Terminal block, 3-term	110958

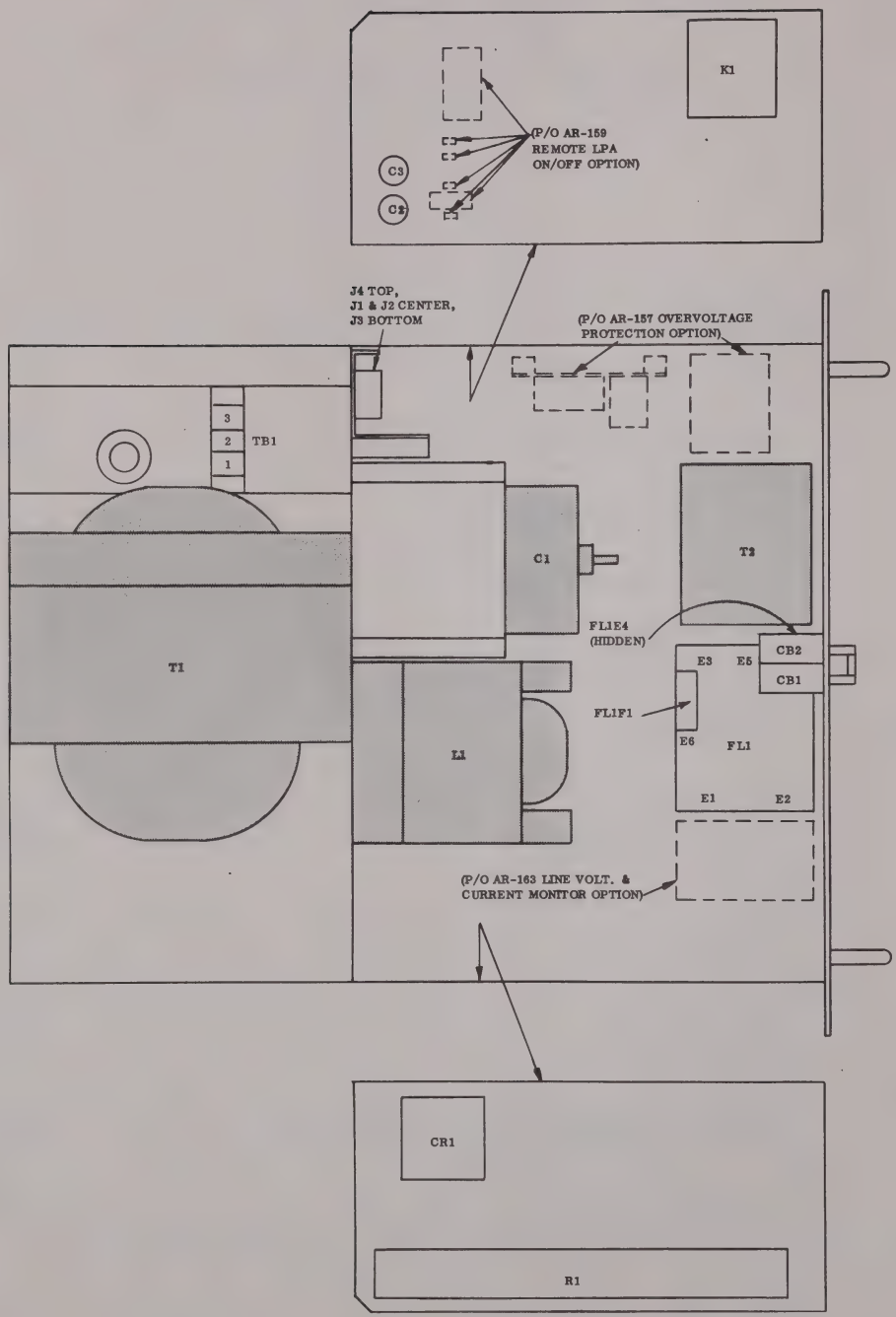


Figure 11-1. AR-150A Power Supply Unit 1A2, Component Locations

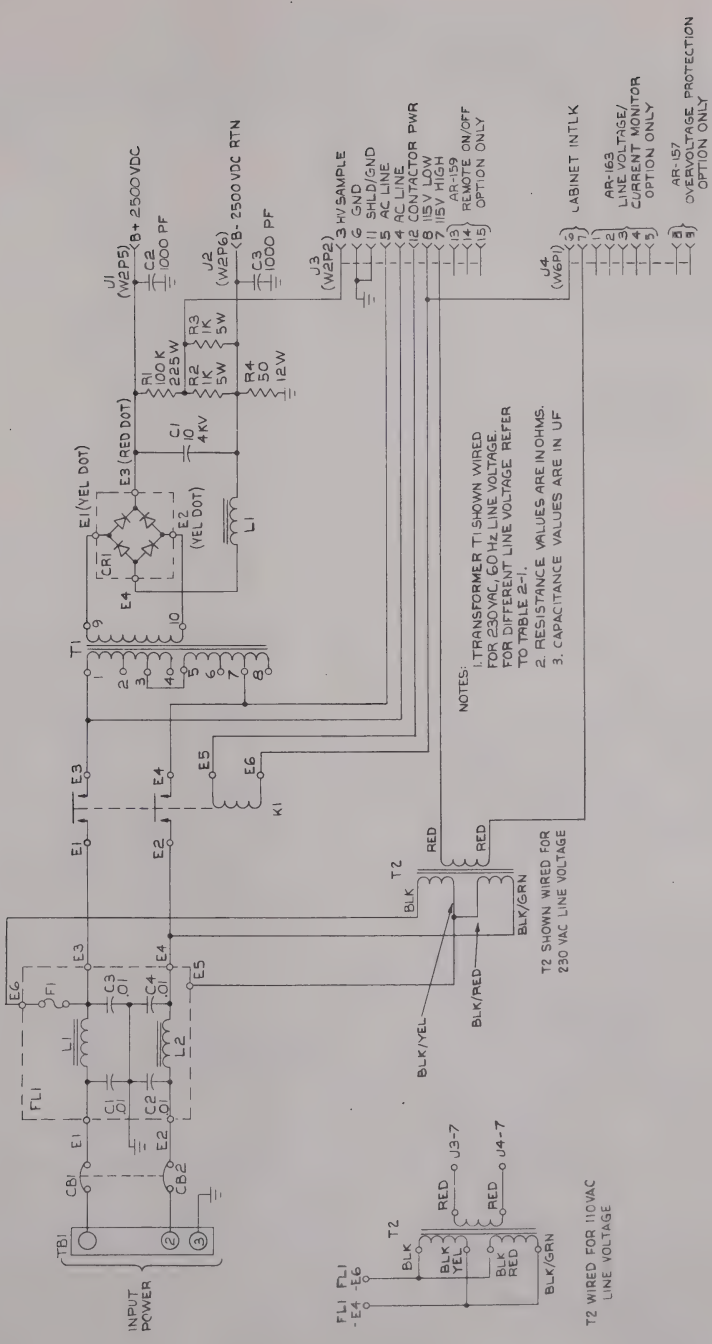


Figure 11-2, AR-150A Power Supply Unit 1A2, Schematic Diagram

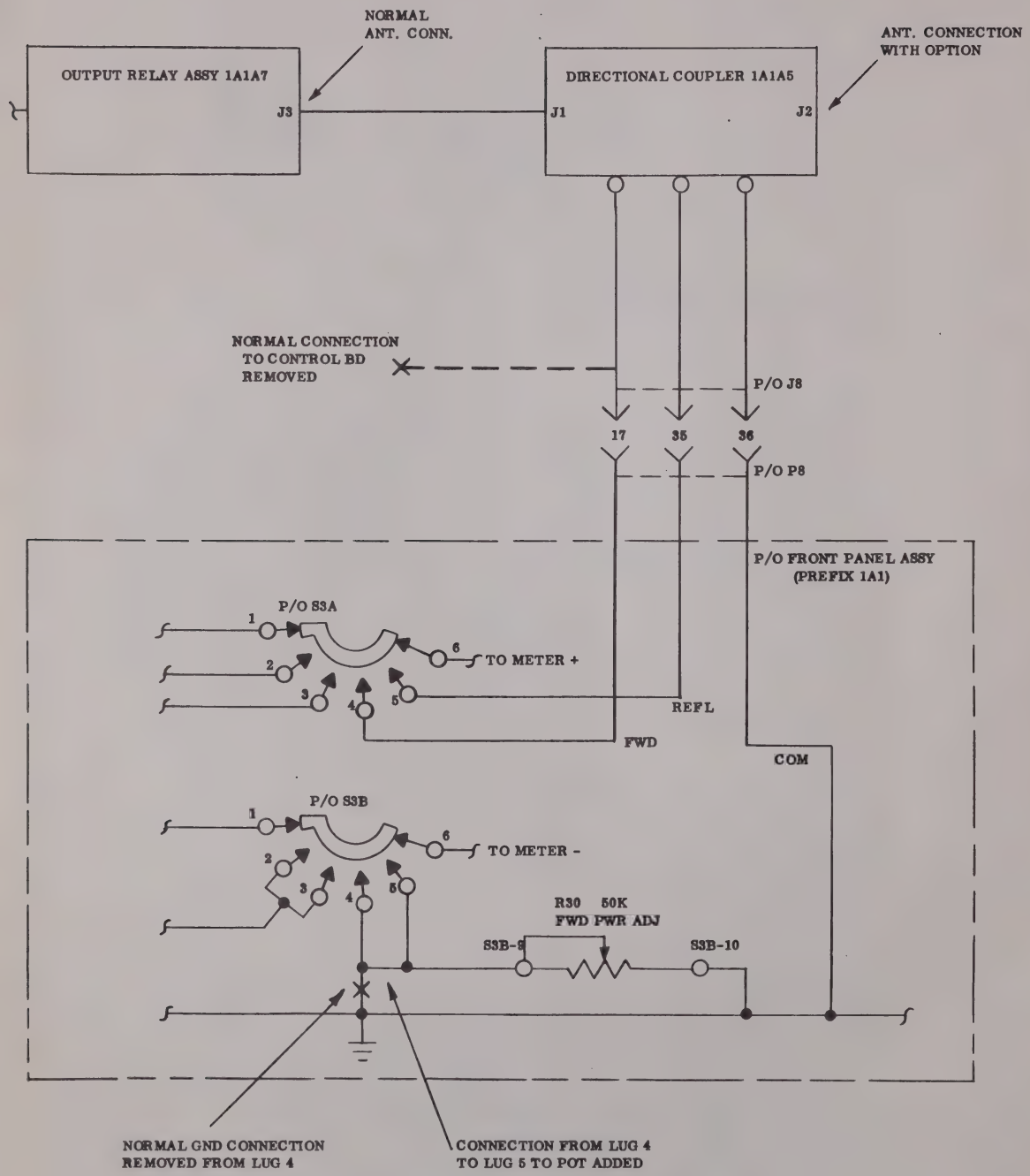


Figure 12-1. AR-156 VSWR Meter Option, Schematic Diagram

CHAPTER 12

AR-156 OPTION, VSWR METER, ASSEMBLY 1A1A5

TABLE OF CONTENTS

Paragraph	Title
12.1	General
12.2	Antenna Connections
12.3	Operation
12.4	Adjustment
----	Parts List
Figure	**Title**
12-1	Schematic Diagram
(Ref Fig 6-3)	Sensor Location

12.1 GENERAL.

The AR-156 Option provides circuitry to indicate both forward and reflected power levels rather than just relative rf output voltage as in the regular LPA.

Refer to the schematic diagram. With this option, position 4 of S3A is disconnected from the Control Board and connected to the forward output of the sensing element (Directional Coupler 1A1A5). Pin 5 of S3A is connected to the reflected output of the sensing element. Pins 4 and 5 of S3B are connected through potentiometer R30 to the common ground return to provide a calibration adjustment.

The Directional Coupler, 1A1A5, is connected in the output rf line from 1A1A7J3 to the antenna. Since it senses power rather than voltage, the meter indication is independent of variations in load impedance.

12.2 ANTENNA CONNECTIONS.

With the option installed, Directional Coupler Assembly 1A1A5 is connected to the normal antenna connector, J3 on Output Relay Assembly 1A1A7. Therefore, the antenna, or a dummy load used for testing, should be connected to the output of the sensor at 1A1A5J2. Figure 6-3 shows the location of the connector, which is at the center rear on the underside of the LPA chassis.

12.3 OPERATION.

Operation of the LPA is as otherwise described in Chapter 3 of this manual, with the exception of the MULTIMETER. In the FWD PWR, REL position, the meter will indicate forward power only. In the REV PWR, REL position, the meter will indicate reflected (reverse) power only. Readings are relative to the calibration established (usually full scale for 1 kW forward power).

As an operating and troubleshooting aid, the meter circuit is very useful. During installation, the antenna vswr can be checked and adjustments can be made if necessary. The 1.5 to 1 maximum vswr allowable corresponds to a reflected power reading 5% of the forward reading. During operation, the operator can occasionally check the condition of his antenna system on each channel. For troubleshooting, the technician can check to determine if problem is caused by a faulty antenna system or if the forward output is low.

12.4 ADJUSTMENT.

Forward and reflected outputs are calibrated in unison with R30, located on the rear of the MULTIMETER switch behind the front panel. The following procedure can be used for calibration of the meter for a full scale reading to equal 1 kW. The calibra-

tion may also be made at a lower level, if desired, especially if the operator prefers to be able to talk the meter up to full scale on voice peaks. (Normally, the meter will only reach approximately 60% on voice peaks due to short duration and voice peak-to-average power ratio characteristics.)

a. Connect dummy load to LPA output at J2 of the sensor. Connect HP-410C or similar rf vtvm to rf cable with HP-11042A or similar T-probe adapter.

b. Remove perforated front panel, and remove screws from LPA front control panel. Slide LPA chassis out, and defeat interlock switches.

WARNING

Defeating interlock switches indicates that hazardous conditions are exposed. Use extreme caution!

c. Set up for operation with a full power single-tone signal. This can be done with CW, FSK, audio signal generator, etc.

d. Set channel switch to a mid-frequency channel (10-15 MHz).

e. Set MULTIMETER switch to FWD PWR, REL.

f. Key set, and adjust drive level for 1000 Watts average output (225 Vrms on vtvm).

g. Adjust R30 behind MULTIMETER switch for full scale reading.

h. Unkey set, and restore system to normal condition.

PARTS LIST

REF DESIG	DESCRIPTION	PART NO.
1A1A5	DIRECTIONAL COUPLER ASSEMBLY	110935
1A1R30	Pot, trim, pc, 50K	R88503

CHAPTER 13
AR-170 OPTION,
SEPARATE CHANNEL OUTPUTS, ASSEMBLY 1A1A6

TABLE OF CONTENTS

Paragraph	Title
13.1	General
13.2	LPA Interface
13.3	Theory of Operation
13.4	Programming
13.5	Antenna Connections
	Parts List

Figure	Title
13-1	Location of Connections
13-2	Schematic Diagram

13.1 GENERAL.

This chapter provides connection and programming procedures, theory of operation, and design disclosure of the 1A1A6 Separate Channel Output Assembly. The purpose of this option is to allow access to any one of several predetermined antennas erected to cover specific frequency ranges. Programming and switching relays allow setup for operation of each channel on any specific antenna, with no restrictions other than the capability of the antenna to operate at the frequency of interest. Thus, if one antenna can cover three channels, such a setup is easily made. This option is available to cover any number of separate outputs from two to ten.

13.2 LPA INTERFACE.

The option physically consists of a chassis fastened to rear rails of the LPA, as shown in figure 13-1. A coaxial cable connects common input connector J11 to the normal LPA output connector (usually 1A1A7J3 on the Output Relay Assembly).

A two-wire power cable provides 24 Vac from terminals 21 (24 Vac) and 17 (ground) of 1TB1, the cabinet junction terminal block. (See Chapter 2 for location.) The power cable has an in-line connector to allow LPA chassis removal from the cabinet.

The channel control lines (as many as required) are permanently connected from 1A1A6TB2 (figure 13-1) to the LPA channel control input terminals of 1A1TB1 (figure 6-3) as follows.

FUNCTION	1A1A6TB2	1A1TB1
CH 1	1	1
CH 2	2	2
CH 3	4	4
CH 4	5	5
CH 5	6	6
CH 6	7	7
CH 7	9	9
CH 8	10	10
CH 9	11	11
CH 10	12	12

13.3 THEORY OF OPERATION.

Antenna relays K1-K10 on the option chassis provide connections from common input coaxial connector J11 to the appropriate output connectors (J1-J10) when the individual relay is energized. Relay coils are powered by 24 Vac from the exciter, which is half-wave rectified and filtered. The ground connection is made through isolation diodes and programming jumpers from channel control lines in the LPA. Thus, when the LPA is commanded to operate on a particular

channel, one relay connects the LPA to the desired antenna.

13.4 PROGRAMMING.

The method of determining which channels are to be connected to which antennas is illustrated by the following example.

Suppose that the channel-antenna correlation is to be:

CHANNEL	ANTENNA
1	1
2	2
3	2
4	3
5	4
6	5
7	5
8	5
9	6
10	4

Then, connections between 1A1A6TB1 and feedthrough capacitors on the chassis would be made as shown in figure 13-1.

Diode designators correspond to channel numbers, and feedthrough capacitor designators correspond to antenna connector numbers. Note that more than one diode can be jumpered to any one capacitor. Jumpers should be soldered in place neatly. They can be changed anytime reprogramming is desired. Following is a blank chart, which you can use to record your programming.

CHANNEL NO. & CR-NO.	ANTENNA J-NO. FT CAP. C-NO.
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

13.5 ANTENNA CONNECTIONS.

The antenna is normally connected to the LPA at output connector 1A1A7J3 on the Output Relay Assembly or at the Directional Coupler option. With the Separate Channel Output Option, the normal output is connected to 1A1A6J11 on the option chassis, and the individual antennas are connected to 1A1A6J1-J10 as arranged by programming.

NOTE

When servicing instructions require dummy load use, it is recommended that a common connector be used in lieu of separate connectors to avoid accidental open-circuit operation when changing channels.

PARTS LIST

REF DESIG	DESCRIPTION	PART NO.
C1-C11	Cap, feedthru, 2300pF, 500 Vdcw	110938
C12-C22	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
C23	Cap, elect, 50μF, +100-10%, 50 Vdcw	C55067
CR1-CR21	Diode, si, 1 Amp, 200V, 1N4003	CR4003
J1-J11	Recept, UHF	J00300
K1-K10	Relay, 3pdt, 12 Vdc	K10010
P1	Plug, in-line, 2 pin	P00202
P1 Mate	Recept, 2 socket, in-line	J00202
TB1	Terminal strip, solder lug type, 5 term	TB0102
	& Terminal strip, solder lug type, 2 term	TB0104
TB2	Terminal strip, solder lug type, 5 term	TB0102
	& Terminal strip, solder lug type, 2 term	TB0104

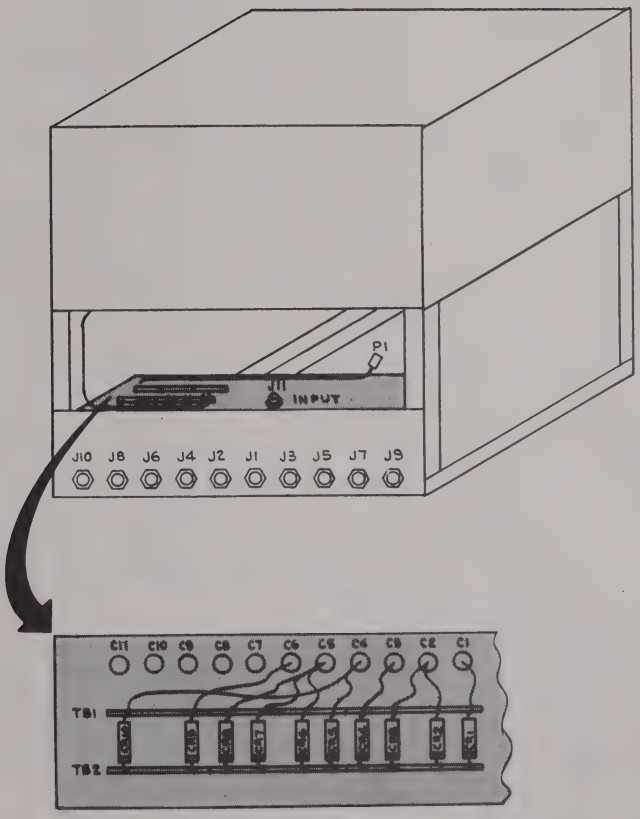


Figure 13-1. Location of Connections

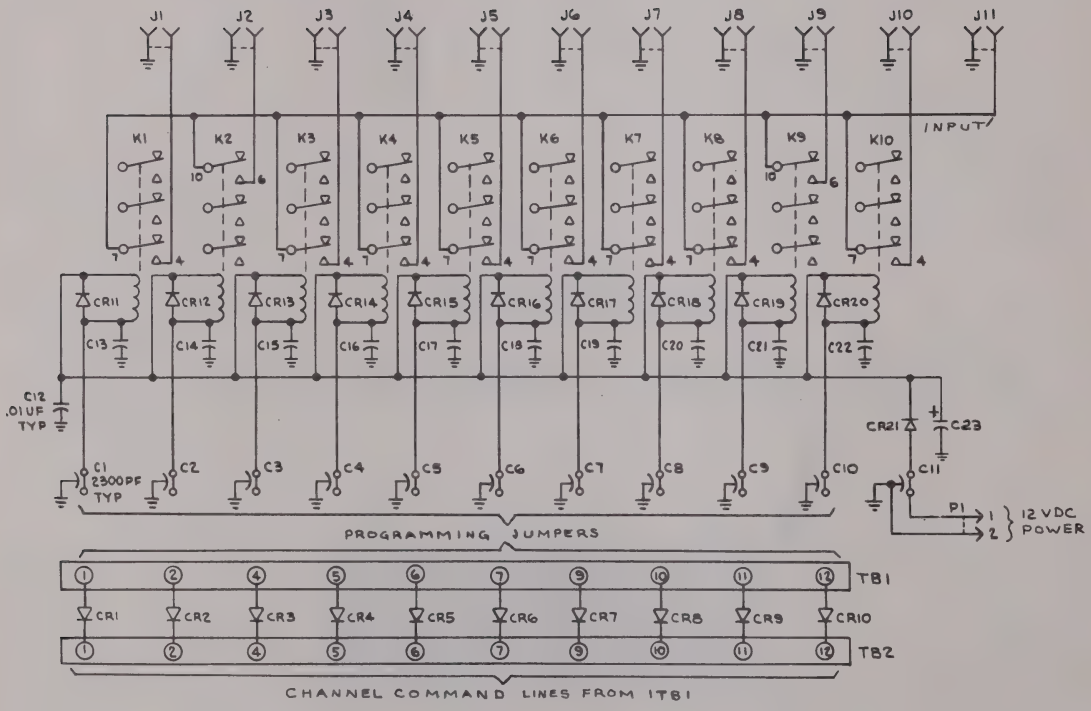


Figure 13-2. Separate Channel Output Assembly 1A1A6, Schematic Diagram

CHAPTER 14

AR-157 OPTION, OVERVOLTAGE PROTECTION, ASSY 1A2A2

TABLE OF CONTENTS

Paragraph	Title
14.1	General
14.2	Operation
14.3	Theory of Operation
14.4	Adjustment Procedure
----	Parts List

Figure	Title
14-1	Overvoltage Prot. Bd. Component Locations
14-2	Schematic Diagram
(Ref. Fig. 11-1)	Board and T3 Locations on Chassis

14.1 GENERAL.

This chapter provides details of operation, theory of operation, adjustment procedure, and design disclosure for the AR-157 Overvoltage Protection Option. The option includes an additional transformer (T3) and pc board for the Power Supply Unit and wiring and wiring changes to connect the optional circuits in the unit.

The function of this option is to automatically disconnect the equipment from the power line if the line voltage exceeds a safe level. The circuit automatically resets when the line voltage returns to a safe level.

14.2 OPERATION.

Operation of the system is unaffected by this option except for automatic shutdown in the event of high line voltage. Adjustment of trip and reset controls is preset to provide a gap of several Volts before the circuit resets to prevent erratic operation if the line voltage remains close to the overvoltage trip threshold.

14.3 THEORY OF OPERATION.

A line voltage sample from 1A2T3 is applied to terminals E1 and E2 of Overvoltage Protection PC Board 1A2A2. The ac sample is rectified by diode bridge 1A2A2CR1-CR4 and filtered by 1A2A2C1. The dc output is applied to the circuit for operating power.

Full operating voltage from the dc line is applied to the emitter of comparator 1A2A2Q1, and its base receives a reference voltage from zener diode 1A2A2VR1 in series with a small variable voltage from the wiper of overvoltage trip level potentiometer 1A2A2R2. If the voltage at the emitter is sufficiently greater than that at the base, the comparator turns on, and relay 1A2A2K1 is energized by switch 1A2A2Q2.

When the relay is energized, contacts 1 and 7 are open, and reset level potentiometer 1A2A2R1 is connected in series with the circuit for potentiometer 1A2A2R2. This lowers the voltage across 1A2A2R2, which in turn lowers the reference voltage at the comparator. Thus, the line voltage must drop below the level which activated the circuit before the relay will drop out. The difference between trip and reset voltages is adjusted by setting 1A2A2R1.

Other contacts of relay 1A2A2K1 are in series with the high voltage contactor coil and in series with the power for the exciter and any auxiliary equipment housed in the LPA cabinet. Thus, power for the LPA and exciter is removed if an overvoltage occurs.

13.4 ADJUSTMENT PROCEDURE.

The overvoltage protection circuit is adjusted by the manufacturer and should not require readjustment except if components are changed in the circuit. If adjustment is necessary, perform the following procedure.

a. De-energize all equipment in the cabinet at the building power distribution panel. Power for the adjustment will be obtained from a separate wall outlet.

b. Turn off PA CIRCUIT BREAKER for added safety.

WARNING

Do not proceed until it is absolutely determined that no primary power is still applied. As soon as the Power Supply is opened up, connect a temporary short circuit across the high voltage filter capacitor before touching anything.

c. Remove screws securing front panel and rear chassis of Power Supply Unit. Slide the unit forward until the front edge rests on the floor.

d. Disconnect the primary of 1A2T3 (see schematic) from the unit, and connect the primary of 1A2T3 to a variable ac power source (variable transformer connected to wall outlet). The voltage should be variable up to 135 Vac, and the current available should be at least 1 Amp.

e. Adjust reset level potentiometer 1A2A2R1 on the pc board (figure 14-1) to its minimum resistance position (shorted).

f. Adjust the variable power source to 15% above nominal line voltage.

g. Adjust overvoltage trip level potentiometer 1A2A2R2 until relay 1A2A2K1 just becomes energized.

h. Adjust variable power source to desired reset level.

i. Adjust reset level potentiometer 1A2A2R1 until the relay just becomes de-energized.

j. Run the variable voltage source up and down, and confirm proper operation.

k. Disconnect variable power source.

l. Reconnect the primary of 1A2T3 to original connection points in unit.

m. Remove short across high voltage filter capacitor.

n. Restore system to operating condition, and turn on building power to system.

REF DESIG	DESCRIPTION	PART NO.
1A2T3	Transformer, 115/10 Vac stepdown	110850
1A2A2	OVERVOLTAGE PROTECTION PCB ASSY	110250
1A2A2C1	Cap, elect, 500μF, 50 Vdcw	C70003
1A2A2CR1-CR4	Diode, si, 1 Amp, 200V, 1N4003	CR4003
1A2A2CR5-CR7	Diode, si, signal, 1N4148	CR4148
1A2A2CR8	Diode, si, 1 Amp, 200V, 1N4003	CR4003
1A2A2K1	Relay, 3pdt, 12 Vdc	K10010
1A2A2Q1	Transistor, pnp, 2N4125	Q41250
1A2A2Q2	Transistor, npn, 2N1613	Q16130
1A2A2R1	Pot, trim, pc, 5K	R88502
1A2A2R2	Pot, trim, pc, 10K	R88103
1A2A2R3	Res, comp, 3.3K, 5%, 1/4W	R20332
1A2A2R4	Res, comp, 3.3K, 5%, 1/4W	R20332
1A2A2R5	Res, comp, 4.7K, 5%, 1/4W	R20472
1A2A2R6	Res, comp, 3.3K, 5%, 1/4W	R20332
1A2A2VR1	Diode, zener, 10V, 5%, 400mW, 1N758A	VR7580

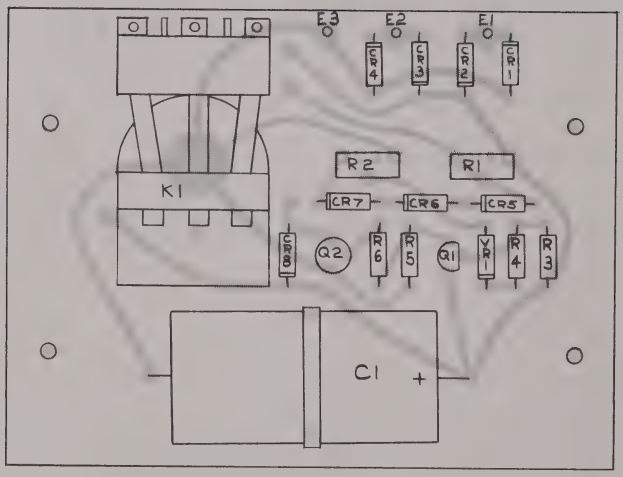
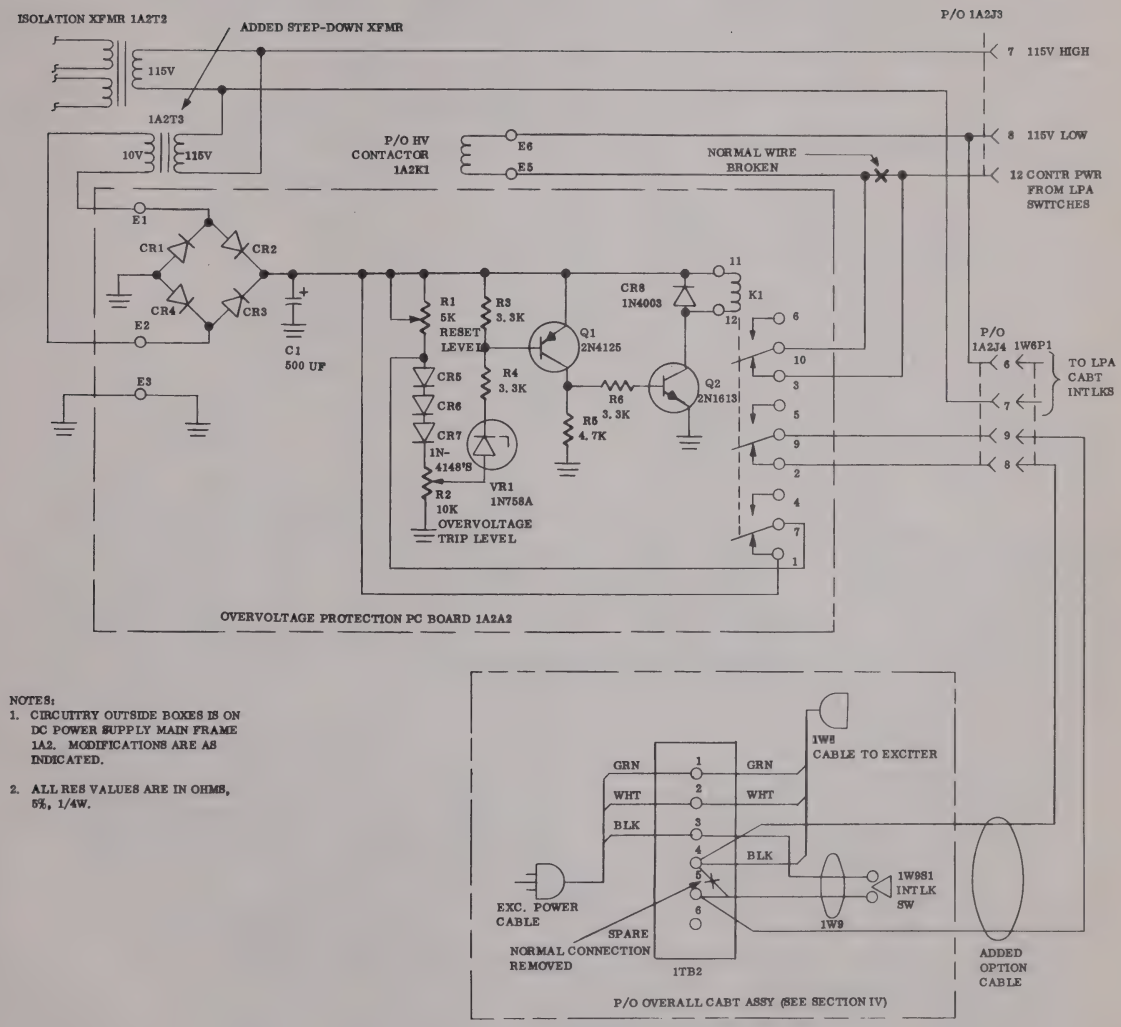
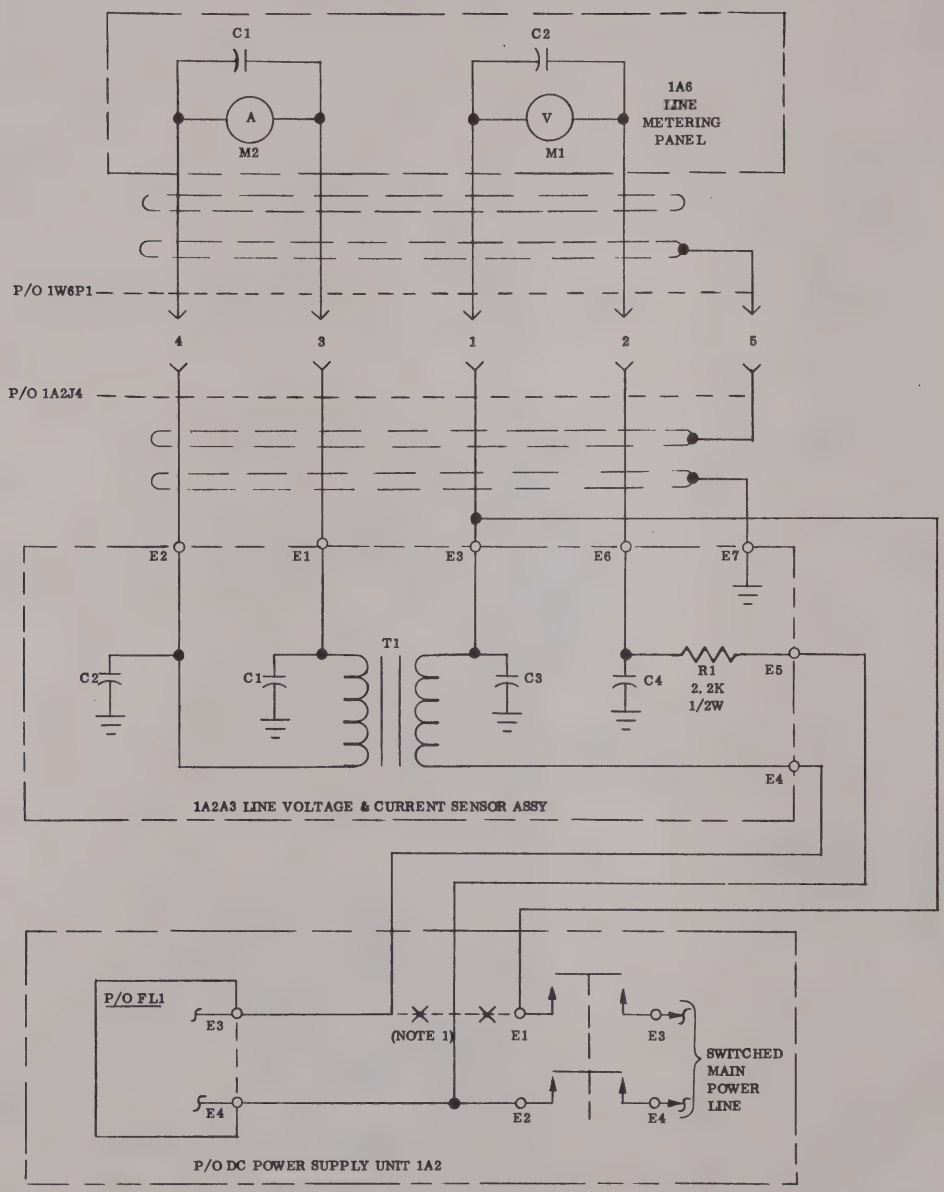


Figure 13-1. Overvoltage Protection PC Board 1A2A2, Component Locations



NOTES:
1. CIRCUITRY OUTSIDE BOXES IS ON DC POWER SUPPLY MAIN FRAME 1A2. MODIFICATIONS ARE AS INDICATED.
2. ALL RES VALUES ARE IN OHMS, 5%, 1/4W.

Figure 14-2. AR-157 Overvoltage Protection Option, Schematic Diagram



NOTES:

1. NORMAL CONNECTION BETWEEN 1A2FL1E3 AND 1A2K1E1 BROKEN TO ALLOW 1A2A3T1 CURRENT SENSING.
2. CAPACITORS ARE .01 μF.

Figure 15-1. AR-163 Line Voltage and Current Monitor Option, Schematic Diagram

CHAPTER 15

AR-163 OPTION,

LINE VOLTAGE AND CURRENT MONITOR, UNIT 1A6

TABLE OF CONTENTS

Paragraph	Title
15.1	General
15.2	Theory of Operation
----	Parts List
Figure	**Title**
15-1	Schematic Diagram

15.1 GENERAL.

This chapter provides operation and theory of operation data and design disclosure for the 1A6 Line Metering Panel and its associated 1A2A3 Line Voltage and Current Sensor Assembly. The former is a separate panel mounted in the front of the cabinet, and the latter is a subassembly added to Power Supply Unit 1A2. The Line Metering Panel has separate meters which provide indications of LPA power line voltage and current at a glance, with no special operating steps required.

15.2 THEORY OF OPERATION.

Figure 15-1 provides a schematic representation of a section of the primary power path in the Power Supply, with modification of wiring and added assemblies shown for the option. The current sensing and line voltage pickoff circuits are housed in a separate subassembly in the Power Supply and are inserted electrically between line filter 1A2FL1 and contactor 1A2K1.

Current sensing is accomplished by routing line current through the primary of 1A2A3T1. A fraction of the line current is coupled through T1 to drive ammeter 1A6M2. Line voltage is sensed across the line between 1A2K1E1 and E2. Resistor 1A2A3R1 provides current limiting in the voltmeter circuit in case of an inadvertent short circuit in the meter circuit cable.

WARNING

The primary line voltage of 115 or 230 Vac is present in the voltmeter circuit including the rear of the meter panel.

REF DESIG	DESCRIPTION	PART NO.
1A2A3	LINE VOLTAGE AND CURRENT SENSOR ASSEMBLY	110775
1A2A3C1-C4	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
1A2A3R1	Res, comp, 2.2K, 5%, 1/2W	R30222
1A2A3T1	Transformer, current	110953
1A6	LINE METERING PANEL	130091
1A6C1-C2	Cap, cer, .01μF, 20%, 500 Vdcw	C10100
1A6M1	Meter, panel, ac volts, 0-300V	110951
1A6M2	Meter, panel, ac current, 0-25 Amp	110952

CHAPTER 16

AR-158 OPTION, REMOTE FAULT INDICATION CIRCUIT

TABLE OF CONTENTS

Paragraph	Title
16.1	General
16.2	Installation
16.3	Operation
16.4	Theory of Operation
----	Parts List
Figure	**Title**
16-1	Component Locations
16-2	Schematic Diagram

16.1 GENERAL.

This chapter provides installation, operation, theory of operation, and design disclosure for the Remote Fault Indication Option. The purpose of this option is to provide relay contacts to allow external fault indicator(s) to be used with the LPA. The external indicator also indicates when the transmitter is keyed into transmit mode.

16.2 INSTALLATION.

Refer to figure 16-2. The circuitry required for this option is installed at the factory. Three sets of "form C" relay contacts are provided, but not wired, to allow the external circuit to be opened or closed in response to relay activation in the LPA. The relay contacts may be used in any manner desired, providing that current through the contacts is limited to 5 Amp and 115 Vac maximum. External wires should be soldered to relay terminals and dressed neatly out the rear of the cabinet. The relay (shown in figure 16-1) is located under the terminal bracket inside the left-hand wall of the cabinet.

16.3 OPERATION.

The external fault indicator will duplicate the response of the TRANSMIT lamp on the front LPA control panel. Conditions are as described for that indicator in Chapter 3. Basically, the external indicator will be energized constantly during periods when the LPA is transmitting (keyed), and it will be alternately energized and de-energized when a fault occurs. Thus, a suggested function label to be used with the remote indicator would be "TRANSMIT-LIT/FAULT-FLASHING".

16.4 THEORY OF OPERATION.

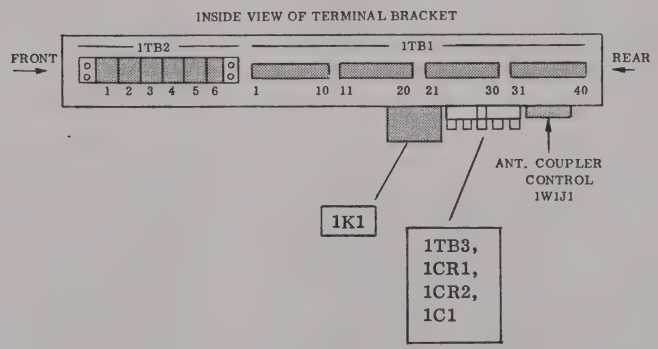
Refer to figures 16-2 and 7-2. A two-transistor switching circuit is added as an integral part of the Control Board when this option is ordered. The TRANSMIT indicator outputs at E27 and E28 are wired to this circuit to provide +12V and a lamp turn-on signal to switch 1A1A1Q101 when the TRANSMIT indicator is activated. The transistor switch provides a positive output in the on-state, and this signal is ripple filtered with 1A1A1R103/C101 and applied to 1A1A1Q102.

A connection from the output of 1A1A1Q102 is made from E36 on the Control Board (see pictorial figure 7-1) through the LPA mainframe and cable 1W1 to system interconnect terminal board 1TB1. The relay and associated components are located under the bracket for 1TB1, and terminal strip 1TB3 provides a mounting point for the soldered components (see figure 16-1).

Relay driver 1A1A1Q102 grounds one terminal of relay 1K1 when turned on. The relay receives power for the coil from a 24 Vac "remote motor" line located nearby on terminal board 1TB1. The ac supply is rectified and filtered by 1CR1 and 1C1 to operate the relay.

PARTS LIST

REF DESIG	DESCRIPTION	PART NO.
1C1	Cap, elect, 50μF, +100-10%, 50 Vdcw	C55067
1CR1-CR2	Diode, si, 1 Amp, 200V, 1N4003	CR4003
1K1	Relay, 3pdt, 12 Vdc	K10010
1TB3	Terminal strip, solder lug type, 5 term	TB0102
1A1A1C101	Cap, tant, 10μF, 10%, 20 Vdcw	C41064
1A1A1CR1	Diode, si, 1 Amp, 200V, 1N4003	CR4003
1A1A1Q101	Transistor, pnp, 50V, 2N5086	Q50860
1A1A1Q102	Transistor, npn, 2N1613	Q16130
1A1A1R101	Res, comp, 2.7K, 5%, 1/4W	R20272
1A1A1R102	Res, comp, 10K, 5%, 1/4W	R20103
1A1A1R103	Res, comp, 1K, 5%, 1/4W	R20102
1A1A1R104	Res, comp, 680Ω, 5%, 1/4W	R20681
1A1A1R105	Res, comp, 2.7K, 5%, 1/4W	R20272



NOTE

Components on Control Board 1A1A1 are illustrated on basic pc board diagram in Chapter 7.

Figure 16-1. Location of Components Under Terminal Board Bracket Inside Left Cabinet Wall

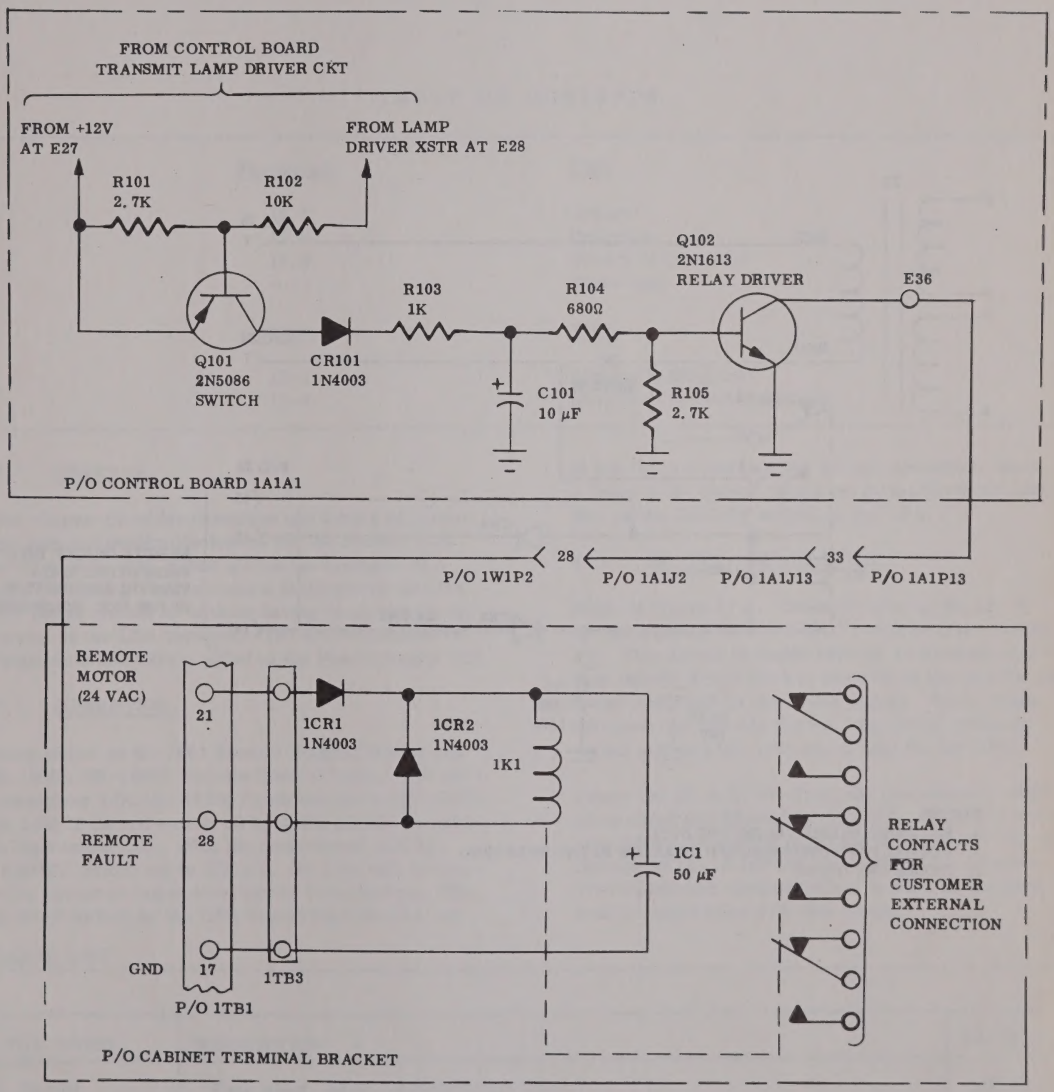
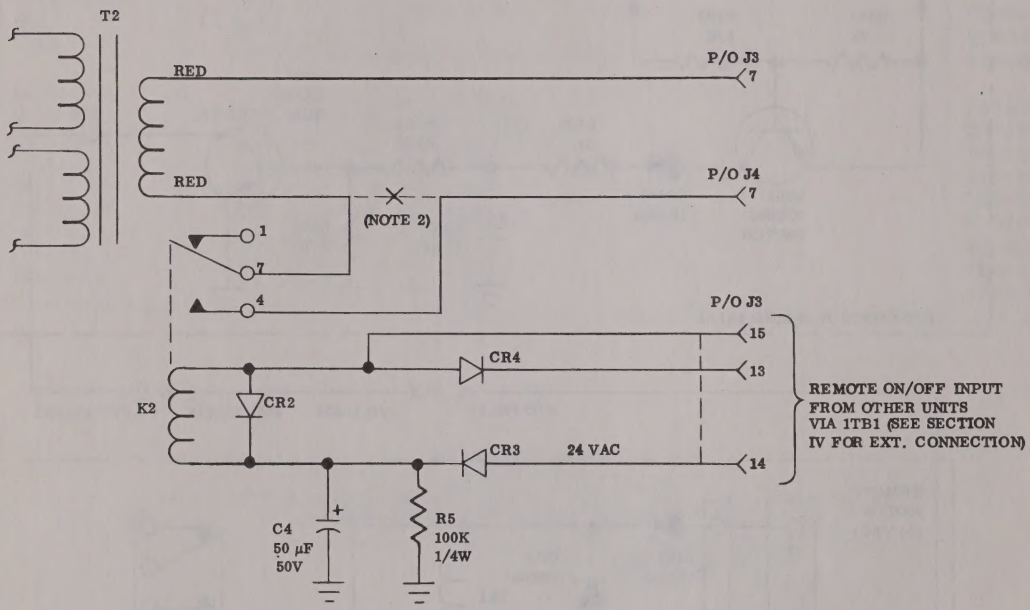


Figure 16-2. Remote Fault/Transmit Circuit, Schematic Diagram



NOTES:
1. REF DESIG PREFIX 1A2 (DC PWR SUP).
2. NORMAL PATH DISCONNECTED TO ALLOW RELAY INSERTION.
3. DIODES ARE 1N4003.

Figure 17-1. Remote LPA On/Off Circuit, Schematic Diagram

CHAPTER 17

AR-159 OPTION, REMOTE LPA ON/OFF CIRCUIT

TABLE OF CONTENTS

Paragraph	Title
17.1	General
17.2	Operation
17.3	Theory of Operation
----	Parts List
Figure	**Title**
17-1	Schematic Diagram
17-2	Simplified System Schematic

17.1 GENERAL.

This chapter provides operation and theory of operation data and design disclosure for the remote LPA on/off option. The option allows the operator of a radio set having remote control facilities to turn the LPA power on and off without having to physically be present at the LPA location. The option consists of components and wiring added to the Power Supply Unit.

17.2 OPERATION.

Using either an SR-1601 Remote Control Unit or the SR-1650L/SR-1650R Remote Control Units, with the transceiver LOCAL/REMOTE switch set to REMOTE, the LPA is turned on and off by a KW ON/OFF switch on the remote unit. With the transceiver LOCAL/REMOTE switch set to LOCAL, the LPA will be turned on whenever transceiver power is turned on. The ON/OFF switch on the LPA should therefore be left in the ON position to allow remote operation, since a relay in the Power Supply performs the same function as the ON/OFF switch on the LPA.

17.3 THEORY OF OPERATION.

Refer to figure 17-1. Contacts of relay K2 are in series with the "115 Vac low" output of transformer T2. This output is routed through an external interlock switch circuit back to one side of the coil for the power contactor in the Power Supply. Thus, when K2 opens the 115 Vac circuit, the power contactor cannot activate the main power line for the LPA.

Power for K2 is 24 Vac from the transceiver, which is rectified and filtered by CR3/C4. Ground to energize K2 can be applied on J3 pin 15 directly to K2 or through J3 pin 13 and isolation diode CR4. Figure 17-2 illustrates various typical system connections used in conjunction with this option.

PARTS LIST

REF DESIG	DESCRIPTION	PART NO.
1A2C4	Cap, elect, 50μF, +100-10%, 50 Vdcw	C55067
1A2CR2-CR4	Diode, si, 1 Amp, 200V, 1N4003	CR4003
1A2K2	Relay, 3pdt, 12 Vdc	K10002
1A2R5	Res, comp, 100K, 5%, 1/4W	R20104

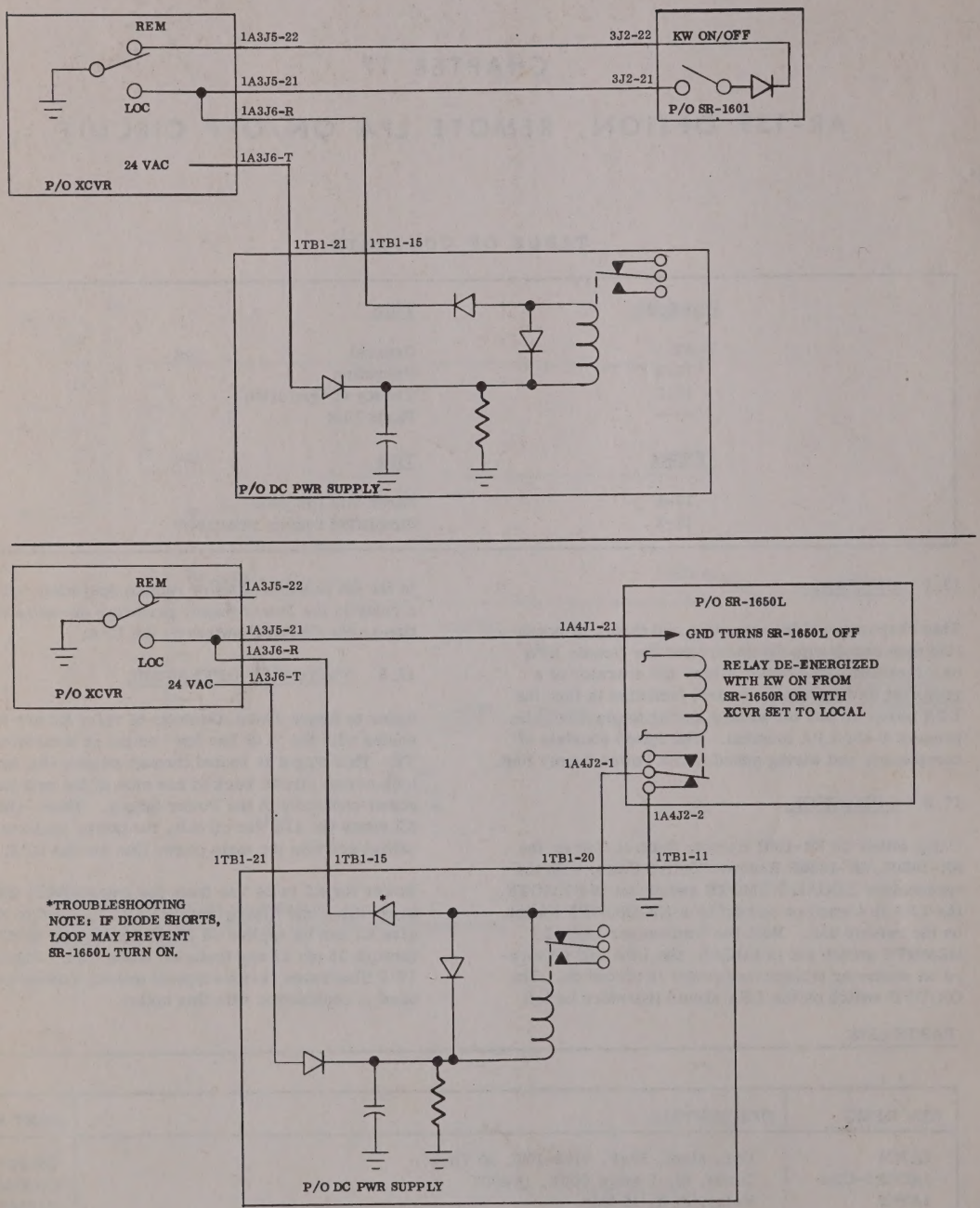


Figure 17-2. Typical System Control Circuits, Simplified Schematic Diagram